# *The* Journal of Heredity

(Formerly the American Breeders' Magazine)

Vol. IX, No. 6 October, 1918


## CONTENTS


Absence of Xenia in Ostrich Eggs, by J. E. Duerden. ..... 243
Why Navel Oranges Are Seedless, by A. D. Shamel ..... 246
Stallion Enrollment Work for 1917 in Indiana ..... 249
Butter Fat Percentage Independent of Age of Cow ..... 249
The Cow in Calf Deserves More Honor, by I. T. Hooper ..... 250
Artificial Hybrids between Pike and Pickerel, by G. C. Embody ..... 253
Is War Necessary? by Paul Popenoe ..... 257
Wanted! Photographs of Twins ..... 262
Hybrids of the Live Oak and Overcup Oak, by H. Ness ..... 263
Mentality of the Arriving Immigrant ..... 268
Will Morality Disappear? by Paul Popenoe ..... 269
Inherited Feeding Habit of Herons, by John T. Zimmer ..... 271
China's Trees and Ours Strikingly Alike ..... 272
Lowered Birth Rate in Germany and Hungary ..... 281
Bee Keeping May Increase the Cotton Crop, by R. M. Meade ..... 282
Counting the Feeble-minded in New York ..... 285


**NOTE**

Instead of raising the price of membership, and in order to meet the requirements of the War Industries Board, and also because of the drafting of the whole Editorial Staff the July, August and September numbers have been dropped out for 1918. Vol. IX will contain only 8 instead of 12 numbers. Next year, if war conditions are no more unfavorable than this year, 9 numbers will be published.


The Journal of Heredity is published monthly with the exception of July, August and September by the American Genetic Association (formerly called the American Breeders' Associaiton) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

Entered as second-class matter February 24, 1915, at the postoffice at Washington, D. C., under the act of August 24, 1912.


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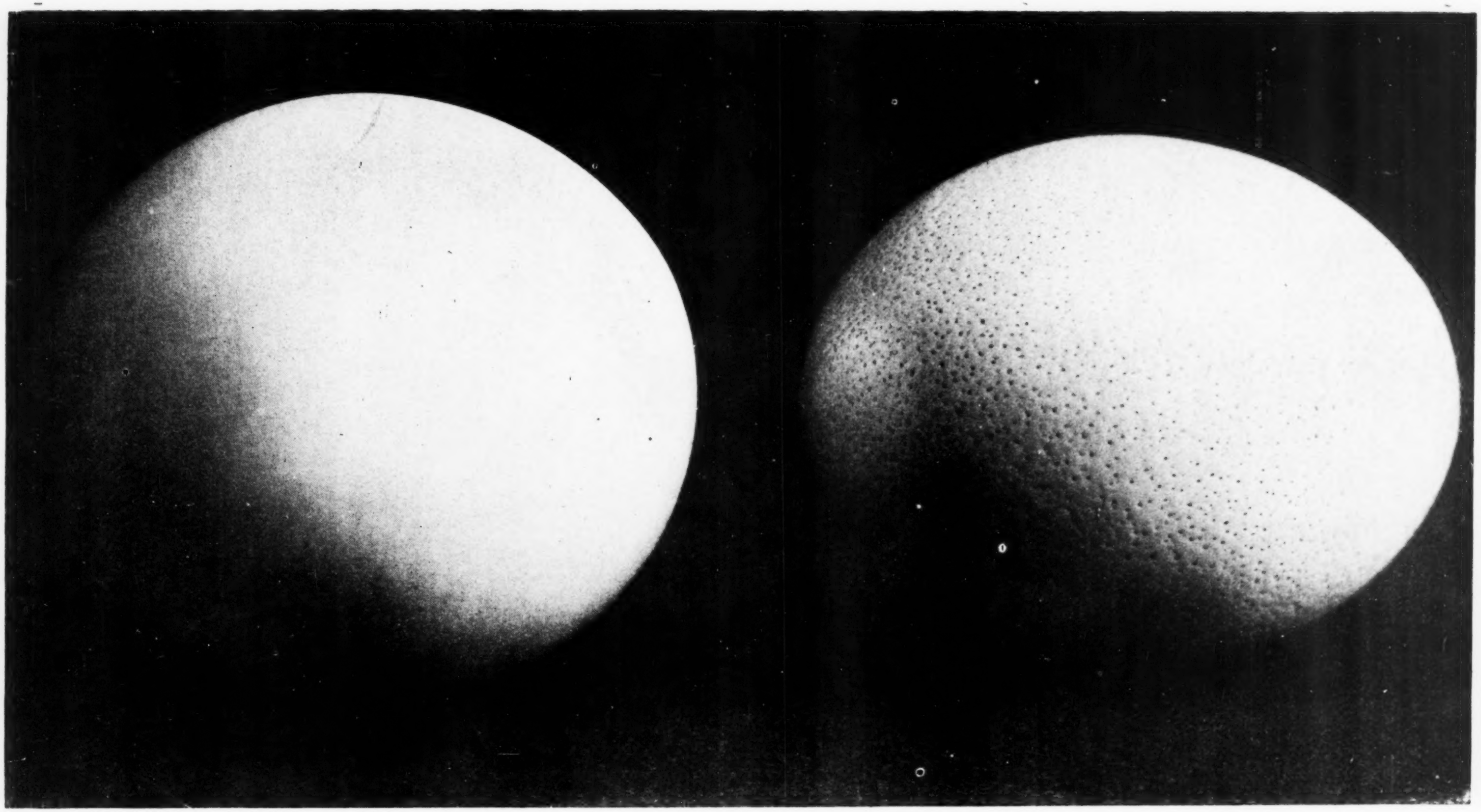
Date of issue of this number, November 13, 1918.



**TWO SPECIES OF OSTRICH EGGS**

The North African Ostrich Egg shown on the left is larger, rounder, and has a very different shell surface from that of the South African species shown on the right. The pores in the South African ostrich egg are conspicuous whereas in the North African they are too small to appear in the photograph. The North African Ostrich always lays an egg like the one shown here on the left, no matter what species of ostrich she has mated with. In other words, there is no evidence of xenia or influence of the father's characteristic upon the shell of the egg. The father's influence affects only the chick inside the egg. On the other hand the outside of a kernel of corn, which corresponds roughly to the shell of the egg, does show xenia. (Frontispiece.)

# ABSENCE OF XENIA IN OSTRICH EGGS

## South African Ostrich Hens Mated with North African Ostrich Cocks Lay Eggs Characteristic of Their Own Species—No Signs of Male Influence on the Egg Shells—No Xenia

J. E. DUERDEN, M.Sc., PH.D.

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IN THE JOURNAL OF HEREDITY for May, 1915, Vol. vi, No. 5, appears a review of certain investigations on xenia in fowls. By xenia is there understood "that the eggs laid by a hen are influenced as to size, shape and color by the cock with which she is mated." The occurrence of xenia in plants is first noted. Here cross-pollination is often found to have an influence on the character of the seed obtained directly from the cross, a result which is shown to be readily explained from the peculiar formation of the endosperm, where one of the two nuclei from the foreign pollen is involved in its production. The reviewer then discusses the various instances which have been adduced as showing some paternal influence on bird's eggs, especially those of Holdefleiss and Walther with fowls and Armin von Tschermak with canaries and finches. The conclusion arrived at is that "the evidence of xenia in poultry is certainly not adequate." The article closes with the statement that "the question is a recent one, and much work may yet be done on it, but until such work is done, xenia in fowls must be considered an open question."

Some recent work in crossing the North African and South African ostrich upon which the present writer has been engaged for some time affords very conclusive evidence in support of the above contention and, although distinctly negative in character, seems well worthy of record, since it represents such a clear cut test case. In 1912 the Government of the Union of South Africa imported 132 specimens of the North African ostrich from Nigeria with the object of possibly improving the domesticated Cape strains, built up during the past fifty years of ostrich farming from the original South African wild bird. The imported birds, originally captured by the Arabs from wild nests, were stationed at the Grootfontein School of Agriculture, and the breeding experiments in connection with them were placed in charge of the writer.

Zoologists generally recognize four species of the ostrich genus, *Struthio:* The North African ostrich, *S. camelus*, Linn.; the South African ostrich, *S. australis*, Gurney; the East African ostrich, *S. massaicus*, Naumann; and the Somali ostrich, *S. molybdophanes*, Reichenow. The two last mentioned are however not well established species, appearing to represent only intermediate types of the other two. On the other hand the northern and the southern birds have clearly defined distinguishing characteristics as regards bodily size and color, nature of the egg, and other minor features. Observing them side by side as can be done at Grootfontein, without any intermediate forms, no one would hesitate in assigning them specific distinction.

As in all other birds the eggs from the same ostrich and also from different ostriches vary within certain limits as regards size, shape and surface characters. But beyond these fluctuating variations several well defined and constant differences distinguish the egg of the North African from that of the South African ostrich; and it is the presence of these which affords such a decisive test as to the occurrence or

otherwise of xenia. The egg of the northern bird is always larger than that of the southern, the shell is almost free from obvious pores or pittings, and presents an ivory-like, smooth surface. Usually also the northern egg is rounder in shape or less oval, the two diameters being more nearly equal. On the other hand the egg of the southern bird is distinctly oval and is deeply pitted all over the surface, the pits often larger and more plentiful around the air-chamber end; and in consequence of the pittings the surface does not present the ivory smoothness of the northern egg. Both however are of the same cream color when freshly laid, becoming lighter on exposure. Among a number of eggs from northern and southern birds mixed together no mistake could possibly be made in separating the one kind from the other.

As regards actual dimensions the average long diameter of 43 northern eggs was 6.15 inches and the short diameter 5.35 inches; the average long diameter of 22 southern eggs was 5.96 inches and the short diameter 4.95 inches. Thus on the average the northern egg is about one-fifth of an inch longer and two-fifths of an inch broader than the southern egg; the former has an average weight of 3 pounds 11 ounces and the latter of 3 pounds 3 ounces. The mean difference in the two diameters is 0.8 inch for the northern and 1 inch for the southern, indicating that the former are rounder or less oval than the latter.

The pitting which gives such a characteristic difference to the appearance of the two kinds of eggs is associated with the respiratory pores of the shell. In the northern egg pores occur, but are so small and open so close to the surface as to be scarcely visible to the naked eye, and are mostly scattered singly with but little grouping. In consequence the surface appears almost uniformly smooth, though a fine pitting can be detected with a lens. In the southern egg the respiratory pores are larger, sunken below the general surface and mostly in small groups, varying from about six to twelve in a group. The close grouping of the sunken pores gives rise to the deeply pitted surface of the shell, often emphasized in the nest by the adherence of small particles of earth.

Whether the northern and the southern ostrich are to be regarded as distinct species depends largely upon one's conception of the term species. At any rate the two are found to interbreed freely and reciprocally, and the crosses or hybrids have also been proved to breed freely, both inter se and with either of the parent forms. About 200 eggs from the cross-matings have hitherto been obtained, both from Nigerian cocks mated with Cape hens and from Cape cocks mated with Nigerian hens. Breeding ostriches are kept apart from all others in large fenced camps, a breeding set consisting of a single cock and one or two hens; and there is never any possibility of confusion as to the pairings and the individual hen laying the twelve to eighteen eggs which constitute a nest.

The nests are visited from time to time to observe their progress, and in view of the possibility of xenia occurring the characters of all the eggs have been closely noted. Without any hesitancy it can be stated that *in no case have the eggs shown any influence from the cock; northern hens mated with southern cocks have always laid large, rounded, smooth, unpitted eggs and southern hens mated with northern cocks have always laid smaller, more oval, deeply pitted eggs.* The experienced eye can at a glance distinguish one kind of egg from the other as regards size, shape, nature of the surface and pitting; and in no instance have the eggs been different from those which one would expect from the hen irrespective of her mating, or even when unmated.

It can therefore be regarded as established that so far as concerns the egg of the ostrich there is no evidence whatever of the phenomenon of xenia. The size of the ovum, amount of albumen and nature of the shell are the characteristics of the hen just as much as are the external bodily features, and are uninfluenced by the cock with which she is

mated. Knowing the facts of the case this is certainly what any biologist would expect, though there is no á priori reason why the presence of spermatozoa in the oviduct should not affect the secretion of albumen and shell material; hence it may be that in other birds some undoubted influence from the cock may yet be established and thus constitute a true case of xenia.

EGGS FROM CROSS-BRED OSTRICHES

Naturally the fertilized germ within the egg from a cross-mating has very different potentialities from the fertilized germ of a mating where both parents are pure, even though the shell is uninfluenced; and the ostrich derived from the cross-fertilized egg has been found to reveal the influence of both parents. The various dimensions and colors of the body and the characters of the plumage all show intermediate stages between those of the northern and the southern birds, while a bald head-patch occurring in the northern and absent from the southern is found to be dominant, being present in all the cross-bred chicks.

The egg laid by a cross-bred hen as regarded its size, form and surface is, as observed above, quite as much a feature of the bird as are the characters just mentioned, and may be expected to follow the one parent or the other of the hen or partake of the nature of both. It is here that the influence of the cross-mating reveals itself, not in the egg laid by the parent hen with which the cross is made. The average long diameter of 34 eggs laid by cross-bred hens is 5.99 inches and the average short diameter 5.06 inches, which are practically the same as those of the southern egg (5.96; 4.95), but smaller than the northern (6.15; 5.35); the average difference in diameter is 0.93 inch as compared with the 1 inch of the southern and the 0.8 inch of the northern egg. Thus the size and shape of the cross-bred egg follow those of the southern bird rather than the northern. The pittings however are intermediate in number and depth. Obvious pittings are found over the shell of eggs from cross-bred hens, compared with their absence in the northern egg; but are neither so plentiful nor so deep as in eggs from southern birds; the general surface is also more ivory-like than in the southern bird but not so uniform as in the northern.

The eggs therefore laid by a cross-bred hen reveal undoubted influence from the cross-mating; and the experiments have further shown that the characters are unaffected according as the cross-bred hens are mated with cross-bred cocks or with a pure northern or a pure southern cock. The conclusion reached is that in all cases the egg remains unaffected by the cock bird, thus demonstrating the absence of xenia as unmistakably as in the first cross-matings.

# WHY NAVEL ORANGES ARE SEEDLESS

A. D. SHAMEL, *Riverside, Calif.*

THE fruits of the Washington navel orange variety are seedless. The reason for this condition is that the flowers from which the fruits develop are not pollinated.

The Washington navel orange flowers are perfect except that the anthers do not develop pollen. The arrangement and the development of the flowers of this variety are similar to that of seedy varieties of oranges with the important exception of the production of pollen.

The writer has repeatedly pollinated Washington navel orange flowers with pollen secured from the flowers of pollen-bearing citrus varieties as, for example, the Valencia orange. The Valencia pollen was simply dusted over the receptive stigmas of the Washington navel orange flowers. Such flowers, with the exception of those accidentally destroyed, have invariably developed into navel oranges bearing viable seeds.

## SOME SEEDY ORANGES FOUND

Occasionally a Washington navel orange containing one or more seeds has been found in the crops from our performance record trees. About ten such fruits have been found in a total of more than twenty-five thousand examined. This condition may be explained on the grounds of the accidental transfer of pollen from neighboring pollen-bearing citrus flowers through the agency of the common honey bee. During the blooming period bees are always extremely active in securing honey from orange blossoms. They probably accidentally pollinate a few pollenless flowers of the Washington navel orange located near Valencia or other pollen-bearing citrus varieties.

In the crops from the Ruby blood orange performance record trees many fruits are found every year with well-developed navels. The growers of this variety usually explain the presence of navels in the blood oranges as being due to cross-pollination with the navel orange variety. Such is not the case. The navel blood orange fruits are true bud variations. They occur as single fruit, branch, or entire tree variations of the Ruby blood variety. Some of the blood navel fruits are seedless, but usually they contain seeds. The flowers, so far as studied, are perfect and the anthers develop an abundance of viable pollen. The lack of pollen in the flowers of the Washington navel orange is further evidence that the navel blood fruits are not in any way the result of cross-pollination.

## A SEEDY STRAIN

An interesting strain of the navel orange bearing seedy fruits was discovered by the writer near Riverside, California, in 1910. The fruits were habitually fully seeded, usually one seed being found in each section of both the primary and secondary parts of the fruits. The trees and fruits have apparently the same characteristics as those of the Washington navel orange except that the anthers of the flowers develop viable pollen. The seedy strain navel orange flowers also differ from those of the seedless navel orange flowers in that some of the stamens are usually abnormal. Some of them develop a petal-like appearance and anthers which may or may not contain pollen, as can be seen by a close inspection of the accompanying illustration. The seeds in the seedy strain navel orange fruits are due to the pollen-bearing characteristics of the flowers from which the fruits develop. At the time when the stigmatic surface of the pistils of the seedy navel orange strain flowers becomes in a receptive condition, the filaments grow with astonishing rapidity. They thrust the anthers past the stigmas before the petals open. As the anthers brush past the stigmas they burst open and an abun-

**NAVEL ORANGE BLOSSOMS**

The ordinary seedless navel orange is produced from a flower like the one on the left: without pollenation. The light colored short stamens which appear like a crown around the glistening dark pistil bear no pollen. Their anthers are empty. The occasional seedy navel orange is produced by flowers like that on the right which has long stamens, sometimes petal like in character, with large plump anthers filled with pollen. (Fig. 1.)

**A NAVEL ORANGE AND ORDINARY ORANGE FROM THE SAME BRANCH**

The Ruby Blood Orange is normally a seedy orange without a navel (the navel is a miniature orange imbedded in the tip or blossom end of the full sized orange). The photograph shows, produced on the same branch, a Ruby Blood orange of the ordinary type and at the tip of the branch a navel orange of the Ruby Blood variety. This is a case of true bud variation and not a result of pollenation from a navel orange flower. The fruits are cut open lengthwise. The navel appears as a light area in the tip. (Fig. 2.)

dance of pollen falls on to the sticky stigmatic surface. Here the pollen grains germinate and send their pollen tubes down through the pistil to the ovules where fecundation takes place.

### LUDICROUS MISTAKES MADE

The lack of pollen in the flowers of the Washington navel orange variety is responsible for some rather ludicrous mistakes by some so-called breeders of new orange varieties. Every little while the writer receives a letter from, or comes into contact with, men who claim that they have originated a wonderful new orange by crossing the Washington navel orange with the Marsh grapefruit or some other citrus variety. Usually, they say that the pollen from the navel orange flowers has been used in making the alleged cross. An examination of the navel orange trees from which they claim to have gotten their pollen has invariably, so far, revealed the fact that there was no pollen in the flowers borne by these trees. These men, in some cases old orange growers, become very angry when the pollenless condition of their Washington navel orange flowers is pointed out to them.

The seedless characteristic of the navel orange is thus explained by a recent visitor to Southern California: "When the navel oranges are young the growers go about with a knife and perform an operation. The scars left by the knife when the seeds are cut out can be plainly seen at the ends of the oranges."

## Stallion Enrollment Work for 1917 in Indiana

In spite of the fact that the number of mares bred last year was smaller than usual, the Purdue University Agricultural Experiment Station, in Circular No. 73, reports an increase in the number of registered pure-bred stallions and a decrease in the number of grade and scrub stallions and jacks enrolled.

The year 1917 passed with very satisfactory relations between stallion owners and the Enrollment Board. Owners secured their renewals earlier than ever before, and on March 15 it was found that but few were still delinquent.

Due to the fact that the market price of horses has not advanced as has that of cattle and hogs, the amount of breeding done was below the average, but that which was done appears to have been carried out along scientific lines. Many communities have organized horse breeders' associations, and through these are helping establish breeding on a sound basis.

## Butter Fat Percentage Independent of Age of Cow

In the study of factors for production it is very important to know if there is any correlation between age and butter fat test in cows. The mean yearly fat test of eighty-six cows in the Delaware College herd has been studied in relation to age of the cows. Some of these cows have more than one record, and the number of records studied is 104.

The ages of the cows range from one and one-half to fourteen and one-half years, and the mean yearly fat tests show a range of from 3.25% to 7%. The standard deviation in age is 2.54 ± .119 years. The standard deviation in fat test is .74 ± .035%.

The coefficient of correlation, calculated by the usual formula, is —.196 ± .064. Since this coefficient is barely three times the probable error, it cannot be considered at all significant.

The only deduction that follows, therefore, from these studies is that the butter fat test of the milk of a cow is not at all influenced by the age of the cow. This being the case, the study of the hereditary behavior of the percentage of butter fat in the milk of cows of different ages does not in any way affect the accuracy of the results.

# THE COW IN CALF DESERVES MORE HONOR

## Register of Merit of American Jersey Cattle Club Reveals Discrimination Against Cow Carrying Calf During Test Period—Young Cows Now Given the Advantage

J. J. HOOPER

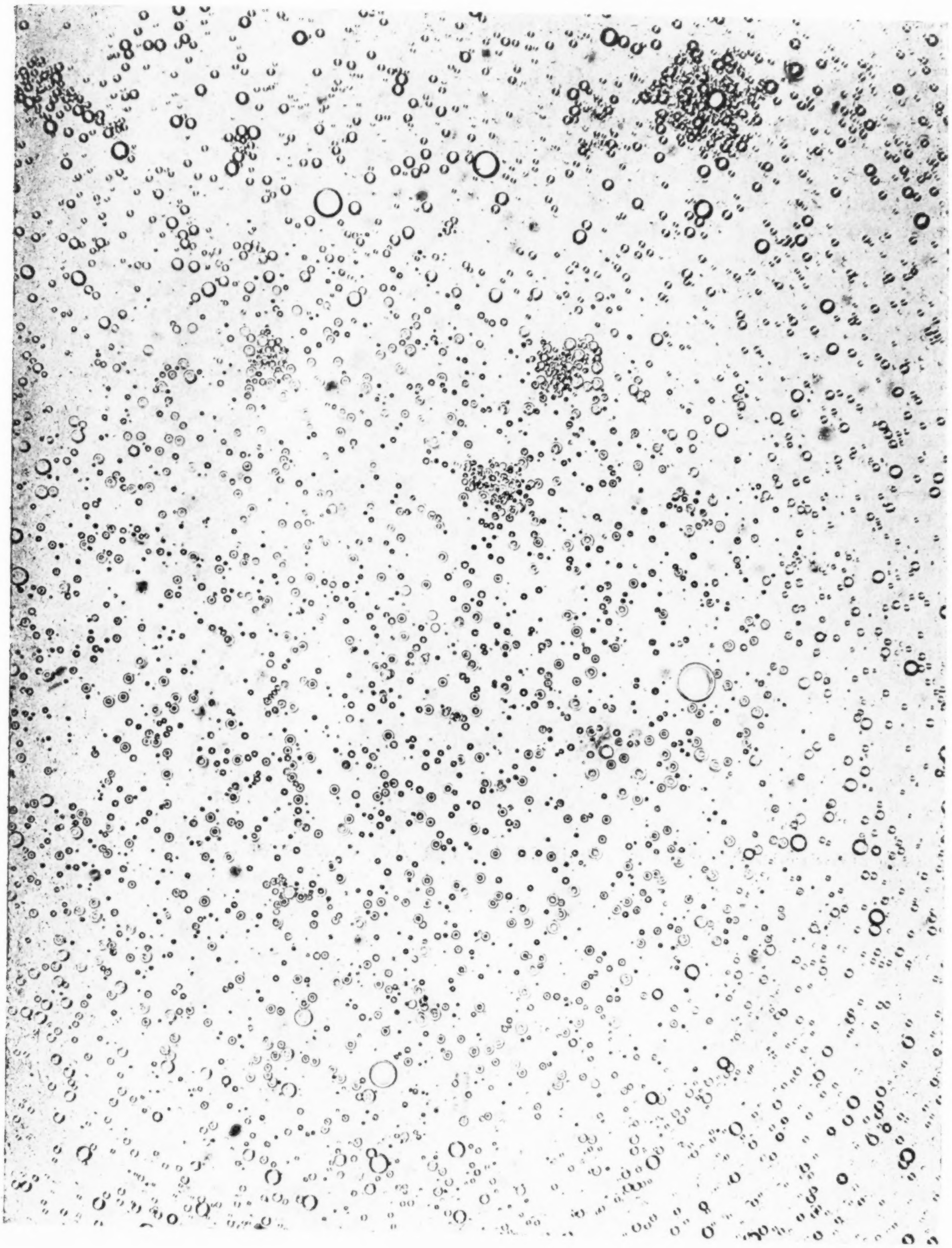
*Kentucky Agricultural Experiment Station*

IT is recognized that breeders of dairy cattle have attained remarkable results in the past decade in increasing the productivity of cows. The standard that has been adopted by breeders of Jersey cattle for Register of Merit cows stipulates that they shall produce at least 250 pounds of fat when two years old (or younger) and one-tenth of a pound more of fat for each day that they are older, until they reach five years of age when the maximum requirement of 360 pounds of fat has been attained. This applies to tests covering a year. No requirement is prescribed for the quantity of milk. It is quite obvious that the standard should be correct and that it should be equally proportioned for all ages. It is hardly fair to place a greater burden on young cows than on old ones, or vice versa.

In this study we have tabulated records of 1,497 Register of Merit cows entered in the volume that was published in 1916. We have kept the records of the A class of cows separate from those of the AA cows. The A cows are not required to carry a calf during the period of their record, while it is stipulated that the AA cows shall carry their calves at least 155 days covered by their test. It is believed that the AA cows are handicapped by carrying a calf *in utero* while making a test and accordingly they are given higher rating by being designated as AA cows.

By reference to the table (See Appendix) it will be found that the A cows averaged a little higher in milk and fat production than the AA cows. It seems that they have a little advantage in that they are only performing one function, that is, milk production while the others are performing two functions, namely, milk production and also the growth of a calf *in utero*. At the same time there is not very much difference in their records, as will be observed by referring to the table or to the graph. There it is shown that for the one- and two-year-old cows there is very little difference between the two classes, but they separate more widely from four to eight years of age. In other words, it seems that a very young cow, with her wonderful vitality, can perform the two functions easily, but at the age of four years she is taxed heavily to carry a calf, in comparison with an A cow. When the cows reach the age of eight to ten years they seem to again possess the ability to carry a calf, without serious detriment to their milk and fat production, in comparison with the A cows. From this study it appears correct that the cows that carry calves for five months or more of the test period deserve some recognition above the other cows, and especially is this true between the ages of four to eight years.

Another interesting point brought out in this study is the fact that the A cows increase in fat and milk production steadily until they reach the age of four years, when they seem to attain almost their maximum production, while the AA cows continue to rise in production until they are five years old, apparently maturing a year later than the A cows.



## A DROP OF MILK

The thousands of different sized round bodies like floating bubbles shown in the photograph are the butter fat globules which in churning are packed together and make butter. The very small dark bodies are not fat. It is these butter fat globules which contain one of the essential vitamines (fat soluble A) necessary for the growth of the human body and it is this fat of the cow which the European world is starving for. The Chinese and Japanese have not become dependent upon it and if their cattle were all destroyed they would not suffer as Europeans have. They get their fat soluble A direct from large quantities of fresh vegetables. If the milk were richer, the fat globules would be larger and more closely crowded together. It is both the amount of milk and the quantity of these globules which are taken into consideration in grading cows. Photograph enlarged 350 diameters by John Howard Paine. (Fig. 3).

YOUNG COWS EXCEED REQUIREMENTS

Possibly the most important point developed in this study is that one- and two-year-old cows greatly exceed their requirements. It has been prescribed that two-year-olds shall produce 250.5 pounds of fat in a year. We find that they actually produce 359.2 pounds of fat. 250 pounds is 69.7% of 359 pounds. In other words these cows produce, in round numbers, 30% more than required. As they grow older the percentage of excess declines year after year, until the ten-year-old cows, that are required to produce 360 pounds of fat, produce actually 463 pounds. 360 pounds is 78% of 463 pounds, and these old cows only exceed requirements, therefore, by 22%. Under the present rules the younger cows have an advantage. If it is desired to standardize the matter so that cows of various ages shall have to produce a quantity of fat in proportion to their demonstrated capacity, then a standard similar to that in column D should be adopted.

Refer first to column A. The two-year old cows have been used as a standard, and column B constructed. Their standard of 250.5 pounds is 30% below their actual production of 359 pounds fat. The standard for ten-year-old cows, 360 pounds, is 22% below actual production of 463.8 pounds. In other words, to give them a similar standard to the two-year-olds would mean that they be required to yield 323 pounds of fat. Or, if we put the young cows on the same basis as the old cows and allow two-year-olds a differential of only 22% of their actual production, then the requirements for two-year-olds should be raised to 280 pounds of fat. As an average the standard is 25% less than production. and we have arranged column D on that basis. The standard in column D would be more fair and just to all ages than the present standard, if our records, embracing 865 A cows are sufficiently extensive to justify a conclusion. We believe more of the old cows would be found in the volumes if this standard, given in column D, were adopted.

PROBLEMS SATISFACTORILY EXPLAINED

The reason we made this study was that we believed the young cows have an advantage, and we are sustained by the data reported upon, but the error is not a serious one. We believed also that it was not very difficult for a cow to carry a calf and produce as large a test as an open cow. Here we were mistaken, because the data show that the AA cows work at some disadvantage, and should receive more honor for making a test that will qualify them for entry in the Register of Merit. We congratulate the American Jersey Cattle Club on the accuracy and correctness of the principle on which the work is based and carried out.

# ARTIFICIAL HYBRIDS BETWEEN PIKE AND PICKEREL

## Crossing Which Is Possible Artificially Appears Sometimes to Occur in Nature —Peculiar Specimens Which Are Occasionally Found Are Probably not Mutants, but True Hybrids

G. C. EMBODY

*Cornell University, Ithaca, N. Y.*

THOSE who have collected and studied the northern pike (*Esox lucius*) from Cayuga Lake, New York, have occasionally come across specimens showing, in one character at least, a condition intermediate between the typical pike and pickerel (*Esox reticulatus*). The question has arisen, whether this is a mutation or has been brought about by natural crossing of the two species. In order to shed some light on the question the writer has studied the spawning behavior of both forms, has determined the spawning time and lastly has crossed the two artificially, rearing the hybrids to a sufficient size to show their principal characters.

In the southern end of Cayuga Lake, the pike begin to enter the marshes and temporarily submerged fields as soon as the ice leaves, which is usually towards the middle of March. Spawning seldom occurs, however, until a week or more later when the temperature of the water approaches 8° C. The pike are accompanied, or closely followed, by the pickerel both in migration and time of spawning. It happens, therefore, that the two species may be spawning over the same area and at the same time.

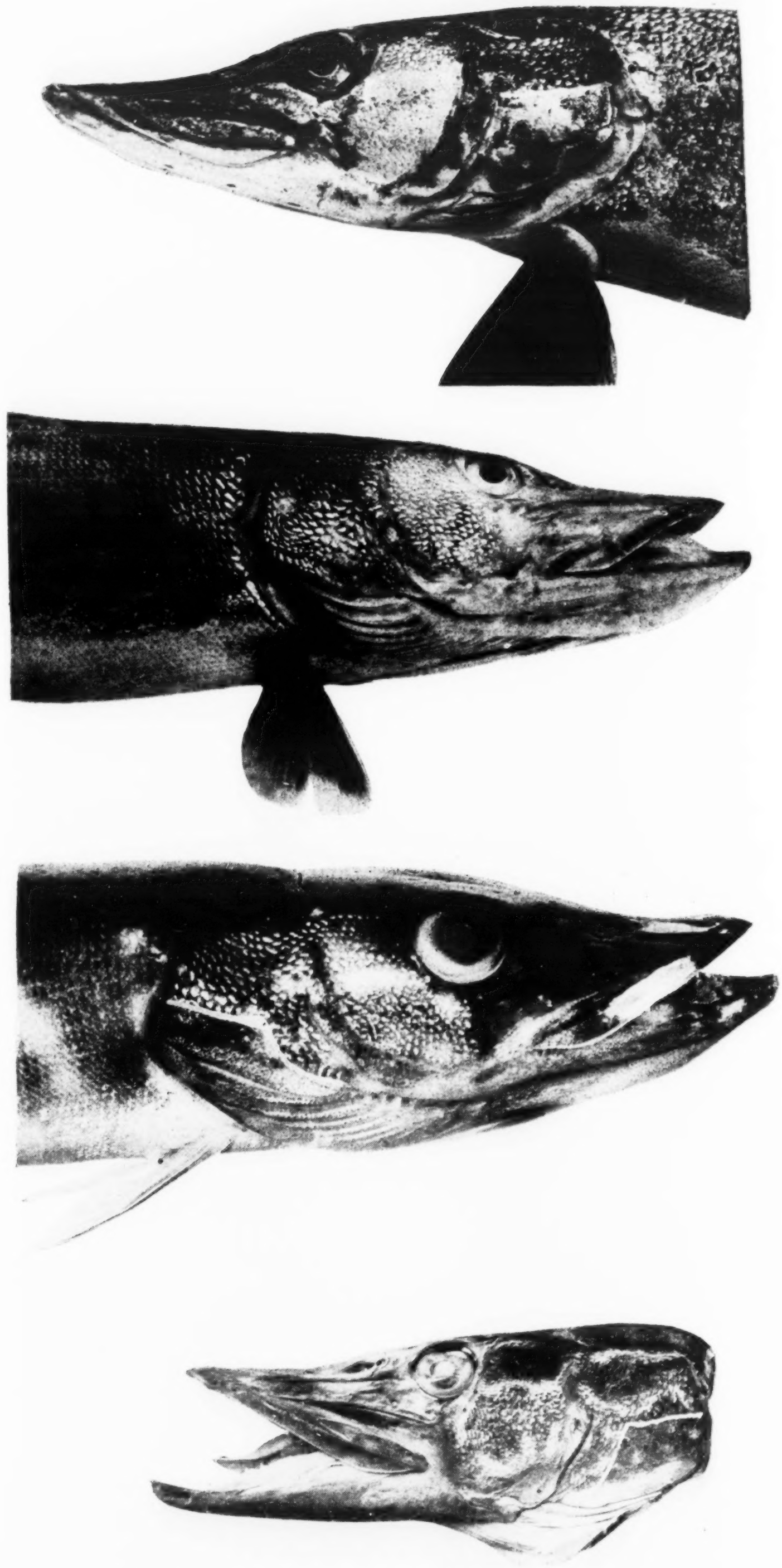
### SPAWNING PICKEREL CROSS MALE PIKE'S PATH

Pike and pickerel are practically identical in their spawning behavior. This may be described briefly as follows: A female accompanied by one or more males swims about in a meandering path. Eggs and milt are cast during widely varying intervals, and at each emission violent lashings of tails tend to distribute both eggs and milt over a comparatively large area. Spawning pickerel have been observed crossing the paths of spawning pike. Should this occur at the proper moment, it is conceivable that a few eggs of one form might come into the area clouded with milt of the other and an accidental cross impregnation take place. No direct matings of pike with pickerel have been observed.

On March 30, 1917, the eggs from a 30.5 cm. pickerel having typical characters were artificially pressed into a moistened pan and covered with milt from a male pike likewise typical of its species. The reciprocal cross was not attempted. About 70% of these eggs developed normally, and those not preserved for future study, hatched in from six to ten days. A few of the young were reared in an aquarium to lengths varying from 3.8 cm. to 6.4 cm. after which they were transferred to a small newly made artificial pond of stagnant water. When six months old three specimens were captured and gave lengths of 15.2, 13.8, and 9.1 cm., respectively.

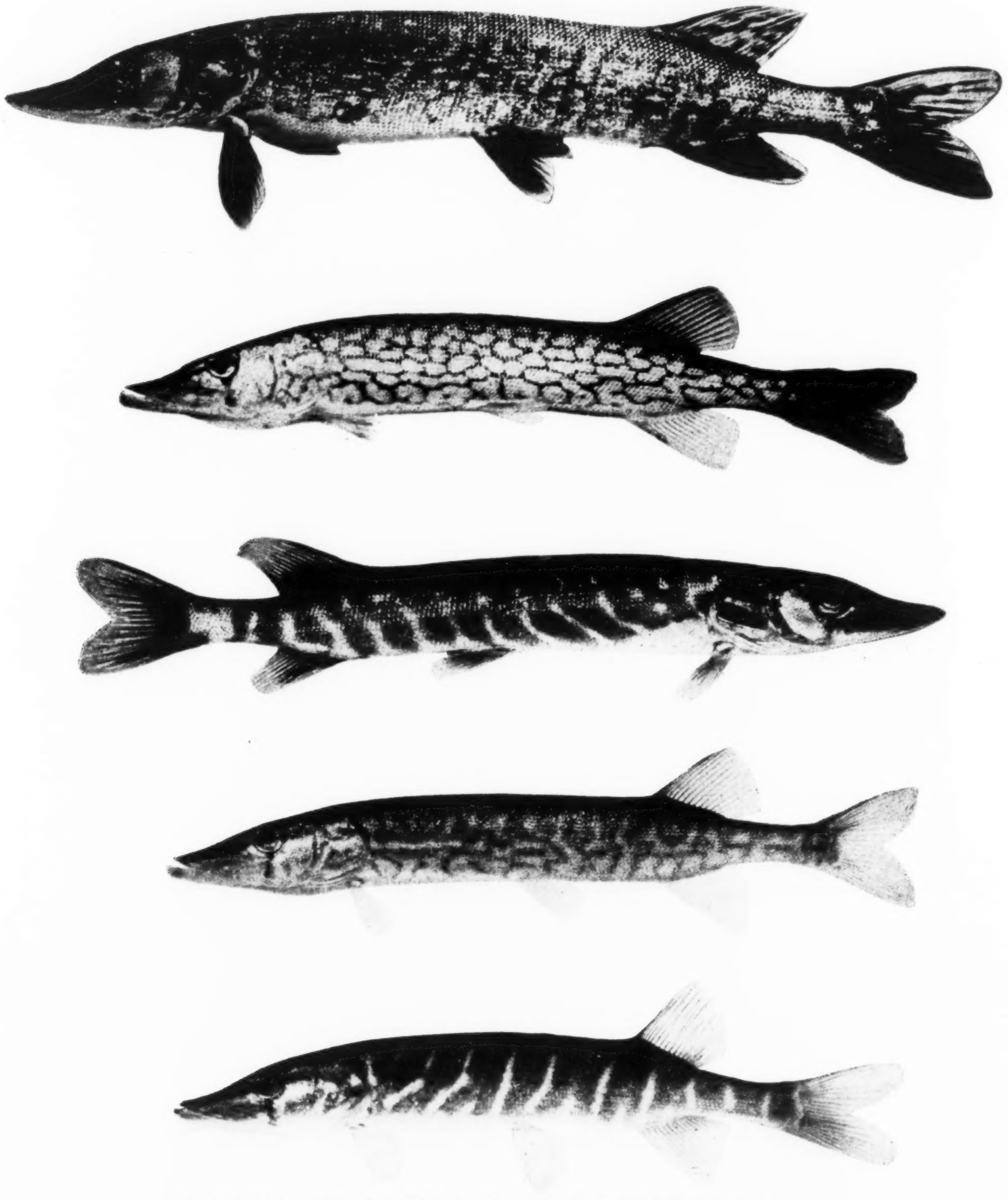
### RECOGNITION CHARACTERS OF PIKE AND PICKEREL

The more obvious external differences between the pike and pickerel are found in the scalation of the opercula and the body color pattern. The extent of the scale covering of the opercula ["gill plates"] has long been considered the best character for the identi-



**HEADS OF PIKE, PICKEREL AND HYBRIDS**

Head of adult pike at top. Extent of scale covering on operculum [gill covering] indicated by white line. Head of adult pickerel, operculum fully scaled. Head of artificially produced hybrid. At bottom, head of supposed hybrid, captured in Cayuga Lake. White line indicates extent to which scales cover the operculum. (Fig. 4, a, b, c, d.)



**PARENTS AND HYBRID OF PIKE X PICKEREL CROSS**

Adult pike and adult pickerel shown at top; young pike, about seven months old, and young pickerel, about nine months old, in center. At bottom, artificially produced pike X pickerel hybrid, eight months old. (Fig. 5, a, b, c, d, e.)

fication of the two species. The color pattern may vary with the age, and with the particular body of water in which the fish lives. In Cayuga Lake, however, the color pattern of adults seems to be well defined and sufficiently constant to permit of identification by this character alone.

### SCALATION OF CHEEKS AND OPERCULA

The head of a typical pike is illustrated in Fig. 4. It will be noticed that the scales extend all the way down on the cheeks and but half way down on the opercula. On the typical pickerel, Fig. 4,b, both the cheeks and opercula are entirely covered with scales. The three artificially produced hybrids, represented by Fig. 4, c, and the supposed natural hybrid, Fig. 4, d, are nearly identical in so far as the scalation of the head is concerned. About one-third of the lower half of the operculum is scaled while the other two-thirds is bare or has only one or two isolated scales. The hybrids are thus intermediate between the pike and pickerel with respect to this character.

### COLOR PATTERN

The color patterns of the adult pike, Fig. 5, and of a supposed natural hybrid of mature size (45 cm. long) are blotches distributed over a darker ground color. In the case of the adult pickerel, Fig. 5, b, the pattern consists of an irregular network of dark lines inclosing a light ground color.

The artificially produced hybrids have not yet reached the age when the adult color pattern appears, but it is possible to compare the juvenile pattern of the pike, pickerel, and hybrid, Figs. 5, c, d, e. The pike and the hybrid resemble each other very closely, the diagonal light bars with broad and darker areas between them being very distinct in both forms. In the case of the juvenile pickerel, the distribution of color is quite different. Instead of distinct oblique bars of light color we have rather indistinct bars and scrolls running in various directions. In the region below the lateral line, there is a tendency to form narrow, dark bars with a broader and lighter area between. How constant this pattern is in the case of the pickerel, is not known, but it is not believed to be variable enough to interfere with the recognition of young pickerel in the presence of young pike. Since the adult pike and the supposed natural hybrid closely resemble each other in color pattern, and since a similar condition obtains between the juvenile pike and the artificially produced hybrid, there is some probability that the mature artificial hybrid will also resemble closely in color pattern the natural hybrid.

### SUMMARY OF FINDINGS

Let us summarize the facts in the case as follows:

The overlapping spawning time and the spawning behavior of the pike (*Esox lucius*) and the pickerel (*Esox reticulatus*) are such as to permit of the possibility of a natural cross.

The eggs of the pickerel may be artificially impregnated with the milt of the pike and may develop into healthy hybrids.

Artificially produced hybrids and supposed natural hybrids are identical in the scalation of the opercula, showing a condition intermediate between typical pickerel and pike.

Typical adult pike and supposed natural hybrids are identical in color pattern.

Juvenile pike and the artificial hybrids are identical in color patterns.

Thus there is a probability that mature artificial hybrids will resemble in color pattern the supposed natural hybrids.

These facts seem to favor the assumption that pike and pickerel occasionally cross in nature.

# IS WAR NECESSARY?

**War a Normal State—Cannot be Abolished by Appeal to Reason or to Sentiment —Problem One of Biology—Bearing of Recent Researches on It.**

PAUL POPENOE

"AS I reflected," says Major George W. Crile, of the Medical Reserve Corps, "upon the intensive application of man to war in cold, rain, and mud; in rivers, canals, and lakes; under ground, in the air, and under the sea; infected with vermin, covered with scabs, adding the stench of his own filthy body to that of his decomposing comrades; hairy, begrimed, bedraggled, yet with unflagging zeal striving eagerly to kill his fellows; and as I felt within myself the mystical urge of the sound of great cannon I realized that war is a normal state of man."

The history of the race has left its mark in every man and woman. Through millions of years mankind fought its way upward. Every individual had to fight to avoid becoming the food of some carnivorous beast. He had to fight against the forces of Nature. He had, further, to fight with his own fellows, to some extent, for food, shelter, and a mate. Any male who could not and would not fight when necessary had small chance of leaving any offspring. It is natural, then, that every human male should still have an inborn disposition to war that, once it has been aroused by the appropriate stimuli, "the impulse to war is stronger than the desire to live." As an organism, man is probably better organized to fight than to do anything else.

War being instinctive in its origin, being an expression of man's inherited nature, it cannot be reasoned out of existence. "If men's actions sprang from desires for what would in fact bring happiness," Bertrand Russell points out[1] in his notable book, *Why Men Fight*, "the purely rational arguments against war would long ago have put an end to it. What makes war difficult to suppress is that it springs from an impulse, rather than from a calculation of the advantages to be derived from war."

Militarists have long recognized this fact and made the most of it. The fighting instinct being the strongest that men possess, militarists think that it is utopian to talk of suppressing it. War is not only natural, but inevitable; the only rational course for a nation to pursue is to recognize this biological fact and prepare to meet war when it comes.

So far as the immediate future is concerned, this is certainly true. But it is the function of science to take a long look ahead, and without hindering the present preparation for war, it may well submit this very important instinct to as searching an analysis as possible.

## SIMILARITY OF WAR AND PEACE

It is sometimes supposed that war and peace are distinct states, but as a fact peace is, for most people, simply war under a different guise, and the transition to war is merely the transition from indirect to direct combat. "Pursuing, escaping, and fighting, the brute adaptations, have been gradually modified during the rise of man, until now in the complicated machinery of modern life the human energy expended by the savage in pursuit and escape and fight is expended in the shop, in transporting commodities on land and sea, in

[1]Why Men Fight, by Bertrand Russell, sometime fellow and lecturer in Trinity College, Cambridge (Eng.). New York: The Century Co., 1917.

preparing armaments, and in pursuing the arts and sciences," says Major Crile, one of the most noted students of the emotions.[2]

"The most powerful activator of man today, therefore, is his fellow-man. He is at war with him in business, in education, in philosophy, in the fine arts, in the professions, in the pulpit, in politics, in winning mates! In all his waking hours and in his dreams he exerts himself against his fellows. The savage stalks or ambushes his enemy or his prey in direct personal effort and settles the issue by physical prowess; civilized man stalks, ambushes and attacks indirectly through the media of trade and commerce. The savage settled his issue in one physical bout; indirectly through the organized community man may hurl himself against his rivals with every atom of his strength for months and years, and though this civilized combat draws no blood and tears no tissue, nevertheless the indirect battle is waged to its finish in bankruptcy, want, suffering, broken health, and premature death.

"The leaders of political parties, of opposing churches, of industrial and commercial corporations, individuals in medicine, law, education, literature, art, music, sports, even in philanthropy daily wage these indirect, but no less destructive, contests. In the field or in the shop the individual exerts his strength directly against his task, so that indirectly the energy he thus expends yields in return food, clothing, and shelter and a modicum of pleasure for him and his family.

### ALL LIFE A BATTLE

"Thus in civilized life man is hurling his energies either directly or indirectly against his environment, to the end that he may live and reproduce. From the simple laborer to the head of the greatest commercial, scientific, educational, or governmental organization, the transformation of energy is made in accordance with the same principle, by the same organs, and for the same reasons as the transformation of energy in uncivilized man or in the lower animals.

"In the selective struggle for existence the acquisition of food developed speed, power, cunning, and craft in all species, but as the food suitable for each species is different, each has developed special activities and special responses to hunger. Man labors long and hard to this end, and the possibility of want is one of his great sources of fear; but a critical analysis will show that there is no difference between the orderly struggle of men to supply their material needs and the brutish attacks of the carnivora upon their prey."

Striking confirmation of this is furnished by a study of the effects which emotions produce in man and other animals. Fear, as Dr. Crile has shown elsewhere,[3] operates to develop certain organs and inhibit others so that every particle of available energy is concentrated upon the fighting mechanism. The advantage that this power must have given to prehistoric man in his struggles against superior foes in a wild environment is apparent to anyone who will allow his imagination to revert to those days of supreme physical contest. And the fact that this operation of fear has not yet undergone any change, although the demands of civilized life are very different from those of a wild existence, is good evidence that man is really ill-adapted to a life of civilization. "In spite of the fact that by harnessing the forces of nature, and by social coördination, which reduces the number of motor reactions, man has progressed vastly in his methods of acquiring food and avoiding danger, his body still responds to threatened moral or financial disaster, as if the old need for physical contest remained. His heart beats wildly; his

[2]A Mechanistic View of War and Peace, by George W. Crile. New York: The Macmillan Co., 1915.

[3]Man—An Adaptive Mechanism, by George W. Crile. New York: The Macmillan Co., 1916. See also The Origin and Nature of the Emotions, by George W. Crile. Philadelphia: W. B. Saunders Co., 1915.

respirations are quickened; he trembles and turns cold; his knees shake; beads of sweat stand upon his brow; he is pale and his mouth dry; he feels faint and may collapse. Whether the cause of fear be moral, social, financial, or intellectual, the result is the same. There is not one form of fear for the defaulting bank president and another for the hunter facing his first big game; not one group of fear phenomena for a mother anxious for her sick child, another for a friend waiting for news from the battlefield, and still another for the soldier facing a superior foe. In every case it is the same fear—fear of bodily harm—expressed in terms of bodily activation, and involving every organ and tissue, which would be involved were the natural phylogenetic response of flight from an enemy consummated in muscular exertion."

### WHY MAN FIGHTS MAN

Much evidence might be given, but for the biologist it is not necessary. He recognizes clearly that man, as an animal, still possesses the strongly developed impulse to fight, which all other mammals have under certain conditions. The principal difference is this—that most animals fight primarily against the environment (including by that term all other animals), rather than against members of their own species. Man, however, long ago got the best of his environment, and the struggle against it has not for thousands of years called for much active physical combat. But the disposition for physical combat being still active, it has to find expression—partly in sports, partly in constructive work, and partly in fighting other members of his own species, to an extent which probably no other animal shows.

The impulse to war, then, is not only deeply ingrained in man's inherent nature, but it is far more complex and firmly entrenched than is generally suspected. It is not surprising that many persons have considered war not only natural but inevitable. Whether or not it is inevitable will be discussed in a moment.

Even if war could be abolished, it is often said it ought not to be, because it is of great value to the race (1) as an instrument of natural selection, and (2) as a source of national energy and racial well-being, as a prevention of decadence and effeteness.

1. The argument that war is beneficial because it allows the fittest to survive has been thoroughly debated in recent years, as a consequence of its espousal by German militaristic philosophers. It is now almost universally known to be fallacious. So far as the physical traits of the individuals of a belligerent nation are concerned, nearly everyone now realizes the strength of the eugenic argument: that, on the whole, war makes for the survival of the unfit rather than of the fit, since those who go to the firing line in a modern war are, on the average, physically superior to those who stay at home.[4] So far as mental traits are concerned, war played a more useful part in the evolution of civilization, up to within a very recent time; for so long as wars were fought by professional soldiers, the institution of war acted as a means of selection to eliminate from the population those who could not conform to the relatively peaceful, industrious, coöperative life which modern society requires. From this point of view, the evolution of society has been made possible by constant warfare, which killed off those in whom the predatory instinct was strongest. But about a century ago, when universal military service was introduced in Prussia and France, this selective effort of evolution ceased and war became, on the whole, as injurious to the race mentally as it has long been physically.

Modern warfare, then, cannot be alleged to be eugenic—to favor selective breeding. On the whole, it has a very injurious influence on national eugenics.

2. The argument that war ought not to be abolished even if it could be; that

[4]See Natural Selection in War, by Roswell H. Johnson. JOURNAL OF HEREDITY, vol. vi., pp. 546-548, December, 1915.

it is a necessary source of national energy; that it is a source of racial well-being, and that peace is inconsistent with a good life for men, is also fairly familiar. While it appears to be repugnant to most Americans, it contains some real stuff. Professor Russell gives a good statement of the case:

"A great many of the impulses which now lead nations to go to war are in themselves essential to any vigorous or progressive life. Without imagination and love of adventure a society soon becomes stagnant and begins to decay. Conflict, provided it is not destructive and brutal, is necessary in order to stimulate men's activities, and to secure the victory of what is living over what is dead or merely traditional. The wish for the triumph of one's own cause, the sense of solidarity with large bodies of men, are not things which a wise man will wish to destroy. It is only the outcome in death and destruction and hatred that is evil. The problem is to keep these impulses, without making war the outlet for them."

How strong these dispositions are can be known from the satisfaction which ensues when they are properly gratified—a satisfaction to which almost every soldier bears witness. "Men say that the wonderful thing about the terrible existence at the front is the sense it gives them of being intensely alive," writes a newspaper correspondent who interviewed many *poilus* in Paris. "Power, energy, endurance they have never imagined comes into their experience. They have a sense of vitality, a keenness never felt in ordinary life." And the experience of a charge is graphically described in *The Forum* by a former English clerk as "by all odds the finest feeling I ever had in my life."

"You can take it from me," he assures his correspondent, "that the most highly colored chromo-lithograph couldn't overdo it, the essential spirit of the thing. Their detail is pretty groggy, of course. No waving plumes, gay colors, flashing swords and polished top-boots. My goodness, no! We were all the color of the foul clay we'd come from—all over. But the spirit of it! It is perfectly hopeless for me to try to tell you, especially in a letter. They say they pump spirits and drugs into the Boches before they leave their trenches. No drug and no champagne, even of the choicest, could have given us any more exhilaration than one felt in that dash from the craters to the first Boche line. Heavens, but it was the real thing! Made one feel you'd never been really and fully alive till then."

### EMOTION REQUIRES OUTLET

That is the sort of innate disposition for war which the biological student must face. Given that man has such inherited impulses, what is he to do with them? Any disposition that is baulked, that fails to find expression, sets up a nervous tension and leads to a degenerate condition, if not to a neurotic one.[5] Man has the fighting disposition, and as a matter of mental hygiene he must do something to "get it out of his system." What is he to do? Sport and business offer a measure of relief, as was pointed out above, but it is evident that they fail to be wholly satisfactory. The problem of science is to find a satisfactory substitute for war; to furnish men with the combat which their systems crave, but to make this combat productive instead of destructive. No amount of appeal to the reason or the emotions will abolish war, but the provision of a proper substitute for war might help to do so.

William James pointed this out clearly in his famous essay[6] on "The Moral Equivalent of War," and marked the path along which those must proceed who want to see the advantages of warfare retained and its highly dysgenic features left out. He suggested a universal conscription of youth, not for military training, but for a fight with the environment in the old, prehistoric way, in reclamation projects, for ex-

[5]This point is well made by Graham Wallas in The Great Society, Chap. ix. New York: The Macmillan Co., 1914.

[6]It was first delivered as an address before a meeting of pacifists during the Spanish-American War, and is printed in a volume on his collected essays.

ample. A year of this, not wholly devoid of hardship, ought to put iron into the soul of a young man, and conversely, take the fight out of him. At the same time, the stimuli to war must be reduced by a more rational system of education, which will show the horrors as well as the glamor of war, and will give more time to Pasteur and Darwin than it does to Napoleon and Marlborough.

### SCIENTIFIC RESEARCH NEEDED

Much research will be required before the question of dealing with this instinct can be fully settled, but several men of science have given attention to it, since William James blazed the way, and have made suggestions that deserve consideration. Major Crile, as described above, points out that many of the activities of normal life give vent to the bellicose disposition. If the most satisfactory of these are extended and intensified, they would still further meet the need of human nature.

Captain Cannon, whose researches on the emotions are already classic, points out[7] that modern warfare no longer satisfies the emotional nature of man as it once did. The exhilaration of a charge across No Man's Land is undeniable; but charges nowadays are few and far between, and most of warfare is of a routine, mechanical nature. War as a psychological instrument for giving "tone" to a nation has been developed too far, he says, and something else is now required. From the physical point of view, he thinks greater extension of competitive athletics would be valuable, and he cites the case of the Igorrot head-hunters of the Philippines, who were turned from the warpath by the Americans and now find an outlet for their energies in sports. From the moral point of view, he thinks the fighting spirit of men should rather be turned against the environment. The great battle should be against pain, disease, poverty and sin, and international warfare of the present kind should rather be regarded as dissension in the ranks.

Professor Russell's discussion of the substitutes for war has been more thoroughgoing than that of anyone else. The first thought that naturally occurs, he says, "is that it would be well if men were more under the dominion of reason. . . . If impulses were more controlled, if thought were less dominated by passion, men would guard their minds against the approaches of war fever, and disputes would be adjusted amicably. This is true, but it is not by itself sufficient. It is only those in whom the desire to think truly is itself a passion who will find this desire adequate to control the passions of war. Only passion can control passion, and only a contrary impulse or desire can check impulse. Reason, as it is preached by traditional moralists, is too negative, too little living, to make a good life. It is not by reason alone that wars can be prevented, but by a positive life of impulses and passions antagonistic to those that lead to war. It is the life of impulse that needs to be changed, not only the life of conscious thought."

### REDIRECTION OF IMPULSES

"Blind impulses sometimes leads to destruction and death," he points out again, "but at other times they lead to the best things the world contains. Blind impulse is the source of war, but it is also the source of science, and art, and love. It is not the weakening of impulse that is to be desired, but the direction of impulse toward life and growth rather than toward death and decay."

"There are three forces on the side of life which require no exceptional mental endowment, which are not very rare at present, and might be very common under better social institutions. They are love, the instinct of constructiveness, and the joy of life." All three of these, he thinks, are checked and enfeebled by the present organization of society, and such social reorganization as will give them freer play will help to make war unnecessary. Professor

[7]Bodily Changes in Pain, Hunger, Fear and Rage, by W. B. Cannon. New York: D. Appleton & Co., 1915.

Russell's book is devoted mainly to a discussion of how the necessary changes might be brought about. State power, private property, education, marriage and religion all receive a searching criticism. One of the factors which he thinks most helpful is political conflict. "Conflicts of party politics, conflicts between capital and labor, and generally all those conflicts of principle which do not involve war, serve many useful purposes, and do very little harm. They increase men's interest in public affairs, they afford a comparatively innocent outlet for the love of contest, and they help to alter laws and institutions, when changing conditions or greater knowledge create the wish for an alteration. Everything that intensifies political life tends to bring about a peaceful interest of the same kind as the interest which leads to desire for war."

### NO SINGLE PANACEA

The biologist will not, of course, make the mistake of thinking that there is any one panacea which will abolish war. Neither universal democracy nor an omnipotent League to Enforce Peace will suffice by itself, although both these developments would be highly desirable. The means for reducing the number of wars in the future may be divided in two classes. First, there must be a reduction in the number and intensity of the stimuli which now stir up the war impulse; this requires changed methods in teaching history and patriotism, and doubtless numerous changes in the organization of society. Second, there must be attempts to guide the impulse to war into productive channels. Universal conscription, as William James suggested, would not only aid largely in this, but would also give the nation an immense army of vigorous young men, to be called upon at any time when the backward state of civilization in other nations made it impossible for this nation to avoid going to war.

There is no hope of an early abolition of war. There is no hope of ever abolishing it by appeals to reason or sentiment. But by the progress of scientific research, and the application of the knowledge thus gained, much can be done, if it is always borne in mind that the problem is one of biology and to be solved only by biological methods which take account of the fact that war *is* a normal state of man.

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## Wanted, Photographs of Twins

The American Genetic Association desires to communicate with twins living in any part of the world. It has been discovered that twins are in a peculiar position to help in the elucidation of certain problems of heredity. Good photographs at all ages are especially desired in order to determine the degree of resemblance and its persistence through life. Any information, giving the addresses of twins, who are willing to cooperate with the Association will be keenly appreciated.

It is known that there are two sorts of twins. (1) The true or "IDENTICAL" twins are developed from a single original egg cell which at some very early stage divided to form two individual beings. These "identical" or "duplicate" twins have a nearly (though never an absolutely) identical germ plasm, are always of the same sex and resemble each other to an extraordinary degree. (2) The other kind, "FRATERNAL" twins are no more alike than brothers and sisters born at different times. They are developed from two separate egg cells.

It is fortunate for our knowledge of heredity that there are these two kinds of twins, on account of the chance it gives to study the relative importance of the influence of heredity and of environment.

It is for the study of this fundamental question of the degree of influence exerted by environment as compared with that due to heredity that the cooperation of the twins of the world is solicited and any publicity given to this notice by the press will be of great assistance.

All Communications should be directed to the American Genetic Association, Washington, D. C.

# HYBRIDS OF THE LIVE OAK AND OVERCUP OAK

**Even the Forest Trees Hybridize and the Forestry of the Future May Have to Take This Fact into Consideration**

H. NESS

*Horticulturist, Texas State Experiment Station*

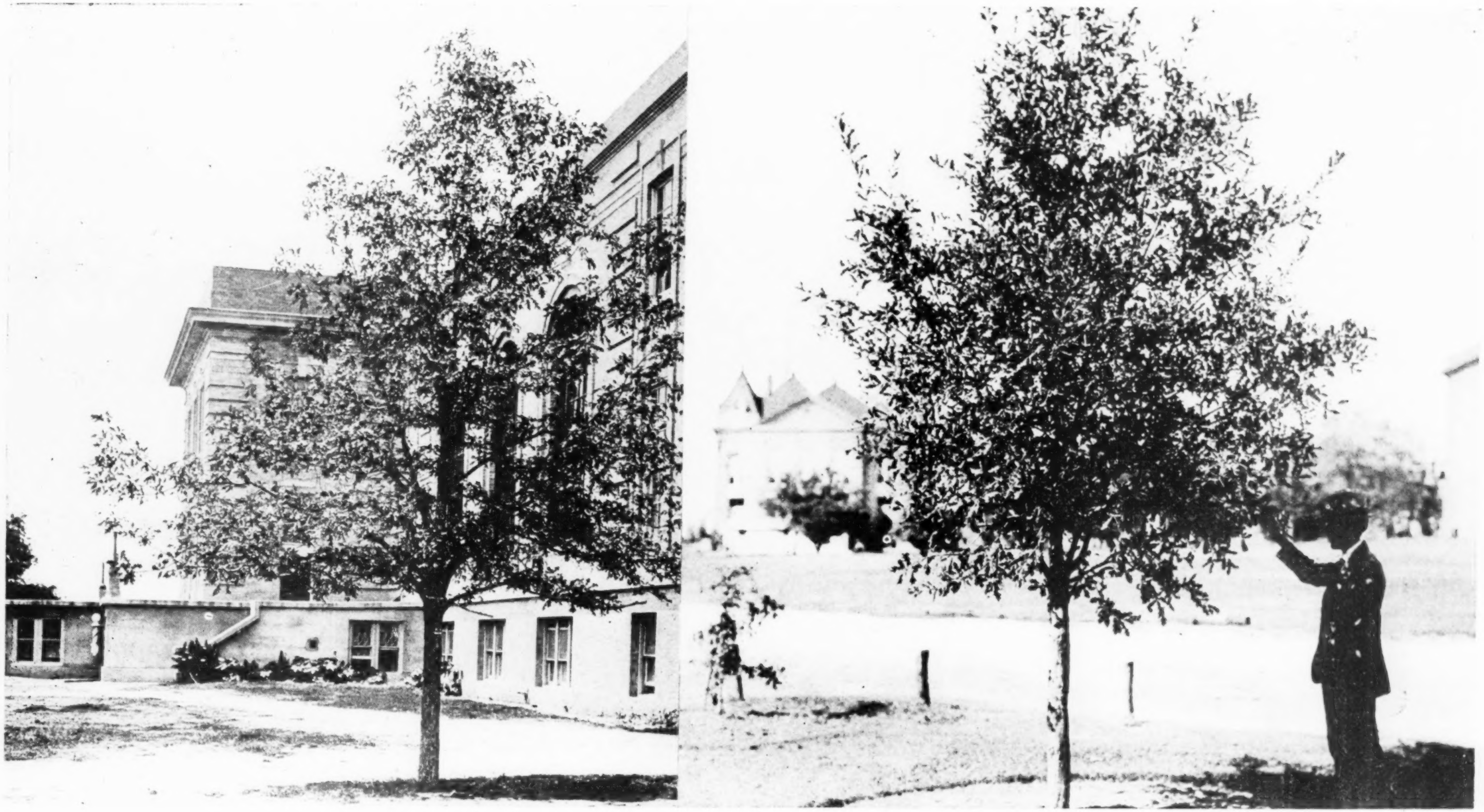
IT IS a fact, long known to botanists, that the systematic assignment of several species of our American oaks presents difficulties and doubts, because of variations that seem to confuse the characters of some of the neighboring species. It is also well known that several natural hybrids occur among the oaks—the number of which would certainly be greatly increased, if their characters merged less with those of one or the other of the parent species.

In a little hybridizing work, which I carried on with the Overcup Oak (*Q. lyrata*) as father and the Live Oak (*Q. Virginiana*) as mother, I have become impressed with the ease with which fertile hybrids may arise between species of oaks, even though the relationship be apparently quite distant. These two species agree in ripening their acorns in one season, hence belong to the same subdivision of the genus, which is called Lepidobalanus. But there is still a strong systematic difference, since they belong to the opposite extremes of that group of species.

They differ widely in habit of growth, in which Live Oak is characterized by its low trunk and a broad, diffuse head of rather crooked limbs and shoots; while the Overcup Oak is of a tall, pyramidal form with straight branches and shoots. Its bark becomes strictly flaky, characteristic of the true white oak group, while in the Live Oak it becomes rough and divided by fissures into numerous narrow and irregular ridges. The foliage of the Live Oak persists throughout the winter until the succeeding spring, while the Overcup Oak is one of the first to shed its leaves in the fall. The texture of the foliage in the Live Oak is strictly coriaceous; the form of the leaves vary from oblong to elliptical with entire or very remotely repand margins. In the Overcup Oak the leaves are four to five times larger than in the Live Oak and more papery texture, with deeply lyrately lobed in margins. But the greatest differences lie in the acorns and the cupules. In the Overcup Oak, the acorn is oblate and nearly covered by the cup, the scales of which are much thickened on the back. In the Live Oak the acorn is ovate, projecting about two-thirds of its length beyond that of the cupule, and the scales are thin, with membranaceous tips and margins.

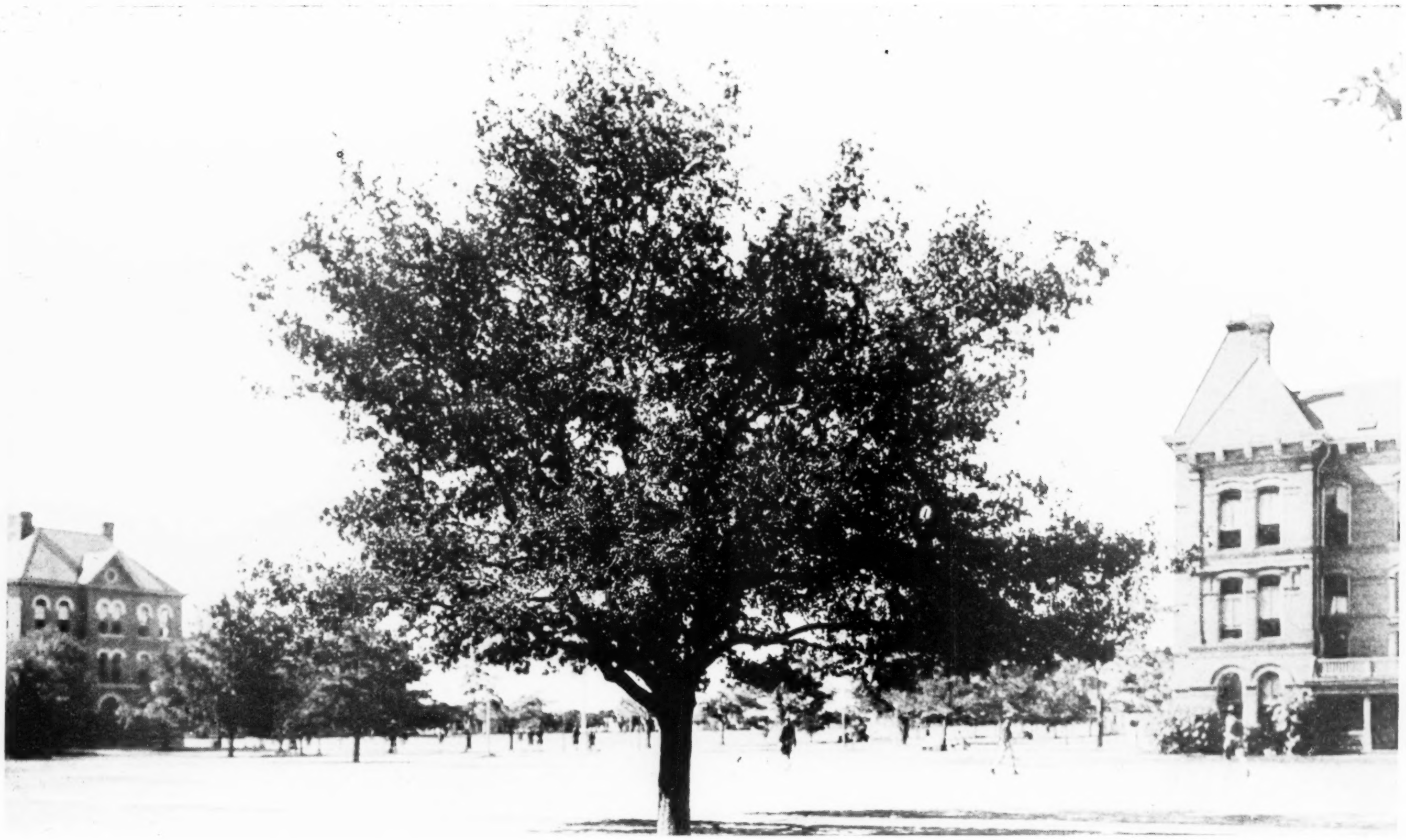
Cross pollination for my first hybrids took place April 6, 1909, after all male flowers on the mother trees and other soak in their vicinity had withered—hence no danger of interference with the cross-pollination. From this cross-pollination nine acorns, of which three were less than normal size, were obtained. The seeds were planted in pots November 9 and gave rise to three young hybrid oaks which were reared in the nursery until March, 1912, when they were planted where they could receive the best care and observation. These trees are, at the present writing, August 28, 1917, about 16 feet tall and with a trunk diameter of about 5 inches, 1 foot from the ground.

On April 14, 1910, a new set of cross-pollinations were made, trees of the same species being again mated in the same order. The result of this is three very vigorous specimens, planted on the laws of the Experiment Station building



**ARTIFICIALLY PRODUCED HYBRID OAK AND ITS FATHER**

Professor Sargent of the Arnold Arboretum described and named after Miss C. C. Compton of Natchez, Miss., a hybrid oak which she has found in the forest. Mr. H. Ness of College Station, Texas, has by artificial pollenation produced the above hybrid tree which is strikingly similar to the natural hybrid. The tree shown on the left is the male parent (*Quercus lyrata*). As an ornamental this hybrid (shown on right) is much superior to either parent because of the density and luster of its foliage. Its wood is hard, close grained and tough. (Fig. 6.)



**THE LIVE OAK MOTHER OF THE HYBRID**

The speed of growth of the Live oak (*Quercus virginiana*) is such that before the hybridizer who successfully crosses it with some other species can really judge of the success of his work his life is gone. He has the pleasure of seeing the young tree grow, and even of sitting in its shade but of its longevity, its ultimate size and its usefulness, others will probably be the judge. He is working for another generation. (Fig. 7.)

in March, 1913. These have during the present unfavorable season added an average of 3 or more feet to the length of every main limb. Of this second lot of hybrids there were originally planted four on the lawn of the Experiment Station building, the most vigorous and beautiful of which succumbed a year ago to the cottonroot rot, and a fifth was planted on the same ground as the first lot. Hence seven young hybrid oaks are growing on the campus, three planted in 1912 and four in 1913.

All these hybrid trees are so uniform in character that seedlings of pure parentage could not be more so. In all of them the father, or *Q. lyrata*, is easily dominant; especially is this true for the second lot, or those from the cross-pollination of 1910. Their pyramidal form and straight shoots are strictly characters of the father. The three of the first lot are less inclined to the pyramidal form of head, and show considerable proclivity to set short-jointed, more or less crooked, lateral branches, after the manner of the Live Oak. The leaves are very uniform in all of them, being intermediate in size of that of the parents. The general outline is oblanceolate with the margins dentately lobed. The texture is strictly cariaceous and of a color of a much deeper green on the upper surface than that of the father species. The leaves commence falling in the winter, but many of them remain green until spring. In the fruit, the Live Oak is strictly dominant except in the size, which is larger and may be considered intermediate. The bark, as it now appears on the lower part of the trunks of the older trees, will be flaky as in the Overcup Oak.

The wood, so far as I have cut into it in pruning, seems to be extremely hard, close-grained, and tough.

As ornamental trees, these hybrids are much superior to the mother, the Live Oak, in form, and to the father, the Overcup Oak, because of the density and luster of their foliage.

One of the three, planted in 1913 by the Experiment Station building, produced several female flowers in 1917, only four years after planting. One of these developed a normal acorn, although no male catkins were produced. The pollen that fertilized this female could possibly come from only two sources, namely, from a Post Oak (*Q. minor*) standing less than 100 feet to the south; or from a Water Oak (*Q. nigra*) standing about twice that distance to the southwest from the hybrid tree producing this acorn. Both of those oaks produced abundance of pollen during the time proper for fertilization of my hybrid oak.

The acorn was planted as soon as ripe, and has at the time of this writing developed into a little tree about 12 inches tall with twelve full grown leaves. The stem is more short-jointed than in any of the individuals of the immediate mother form. The leaves are of the same texture, have similar lobations, but are longer in proportion to the width than in those of the mother type. One or two of the larger of these leaves are strangely similar to the form of leaves frequently borne by strong water shoots upon *Q. nigra*. (I am bearing in mind that *Q. nigra* belongs to that group of oaks, which ripens its fruit in the second season after flowering, namely, the black oaks, or the red oak division of the genus.) My attempts to cross *Q. nigra* with *Q. Virginiana* have up to the present time been fruitless.

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Since the above notes, made on August 24, 1917, a crop of twelve acorns from four mother plants have ripened, been planted, and at this time (June 14, 1918) made a growth varying from 6 to 14 inches in height. As to the immediate male parent of these, there is the same doubt as in the case of the first seedling of the second generation, referred to above. All of them are glabrous with the exceptions of one, which has pubescent stem and under surface of the leaves, strongly similar to a young seedling of a Post Oak. One has the lyrata-form of leaves to a very marked degree.

At the present writing, the form of the leaves seems to be in a state of transition, the later ones being somewhat different in form from the earlier. How-

**ACORNS AND LEAVES OF THE HYBRID OAK AND ITS PARENTS**

The small characteristic acorns and the entire unlobed leaf of the live oak is shown at the upper left. The Overcup Oak acorns with their nearly enclosing cups and much thickened scales, and the deeply lobed leaves, on the upper right. Below are the acorns and leaves of the hybrid which appear intermediate between those of its parents. They are dentately lobed, their texture is coriaceous and they are of a much deeper green than the father species. These leaves commence falling in the winter but many remain green until spring. (Fig. 8.)

ever, similarity to the first generation both in form and texture is a dominant feature, leaving the identification of the immediate male parent in obscurity.

At present a small crop of young acorns are in formation on some of the trees of the first generation; but as only three male catkins were observed on the most fertile of them, the pollen is again from a foreign source.

In this connection it is of considerable pleasure and interest to receive "Notes on North American Trees," just published in the *Botanical Gazette*, vol. lxv, No. 5, by Professor Sargent. In these notes he describes the natural hybrid *Q. lyrata Virginiana*, and names it *Quercus comptonae*, in honor of Miss C. C. Compton, of Natchez, who has assisted him in obtaining specimens of this hybrid from trees growing in her vicinity. Besides in Mississippi, Professor Sargent mentions localities in Louisiana, Alabama and Texas, where this natural hybrid has been found and comments on their great similarity to mine, due to artificial crossing.

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## Mentality of the Arriving Immigrant

After examining 296 immigrants by means of a series of mental tests, E. H. Mullan of the U. S. Public Health Service, reports that but three of them turned out to be positive cases of mental deficiency and had to be certified for deportation as such. Eight others were thought possible cases of mental deficiency but were not certified as such. Twelve immigrants who gave fair responses to test questions exhibited peculiarities which are suggestive of pathological mental states. These symptoms were not, however, taken into account in grading the subjects, as they were thought to belong more properly to the domain of psychiatry.

Those tested included 103 Italians, 50 Hebrews, 26 Russians, 26 Ruthenians, 25 Spaniards, 21 Germans, 11 Poles, 11 Greeks, 4 Norwegians, 3 Lithuanians, 3 West Indian Negroes, 2 Danes and eight of other nationalities. The tests were given through an interpreter and were not such as to allow a classification according to mental age to be easily made. Arithmetical, memory, transitional tests were given and nonarithmetical reasoning tests.

Subjects were scored by a point scale. It would seem that no general statistics have been drawn up for the entire group of either subjects or tests, and for this reason it is impossible to offer many generalizations regarding the findings.

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## Errata

Attention is called to the following errors in the article by Dr. Geo. F. Freeman in Vol. ix, No. 5, of the JOURNAL OF HEREDITY (May-June, 1918):

Page 213.—For Fig. 14 read Fig. 12, for Fig. 15 read Fig. 13, for Plate II read Fig. 13. (This error occurs in three places at the bottom of the page.)

Page 214.—For Plate III read Fig. 14. (This error occurs in 3 places.)

Page 215.—For (*b*) in legend read (*c*).

Page 217.—For Plate III read Fig. 14. (This error occurs in three places at the bottom of the page.)

Page 218.—Column two line, 29, for "tarch" read "starch."

Page 222.—For Fig. 16 read Fig. 14. (Two places.) For Fig. 17 read Fig. 15. (Two places.) For Fig. 18 read Fig. 16. (Two places.)

Dr. Wm. Trelease writes that Fig. 12 on page 407 of the JOURNAL OF HEREDITY, Vol. v, No. 9, is not *Quercus insignis*, but is *Q. cyclobalanoides* Trelease. This oak is a native of Chiapas, Mexico, not of Huatusco, as was stated. Dr. Trelease has illustrated these two species in his article on The Large Fruited American Oaks in The Proceedings of the American Philosophical Society, Vol. liv, No. 216, plate III, 1915.

# WILL MORALITY DISAPPEAR?

PAUL POPENOE

There is much evidence indicating that morality is dependent on heredity —that virtue can only develop with a certain inherited background. If this be true, then the amount of morality in the race will be largely dependent on the birth rate.

It is for obvious reasons difficult to find statistical material in which the parents can be graded according to their morality. Frederick Adams Woods was particularly successful in this respect, in his careful study of European royalty, where by averaging the estimates of historians he was able to form an unusually accurate estimate of the mentality and morality of the sovereigns and their relatives. When he classified the individuals in 10 groups, according to the amount of morality they possessed, he found that the number of children who reached 21 years was correlated with the morality of their parents. Those who were low in virtues had only 1.66 children each, while the moral geniuses at the top of the list brought 3.83 children each to maturity.

While this single investigation is not adequate proof of the correlation between morality and net fertility, yet the result is no more than one would expect. There are many reasons, both medical and economic, why the children of the more vicious and depraved *naturally* die in greater numbers; and if they do, then the evolution of a higher moral state has been brought about partly by selective breeding.

### ROYALTY GOOD WORKING MATERIAL

Royal families furnished particularly good material to test the problem, because there has probably been no artificial restraint of the birth rate there; reasons of policy make monarchs desire to have as large families as possible.

If there were no interference with the course of evolution, if there were no restriction of families among the moral, and if no aid were given to the immoral in bringing up their families, it seems probable that moral people would steadily have the larger families, and the increase of moral qualities in the race would be ensured.

### RESTRAINTS ON SELECTION

How is it nowadays, when every sort of interference with natural selection is found?

It is difficult, as was pointed out above, to find a population in which the individuals can be graded for statistical purposes; but we can easily find populations all of whom are, on the whole, superior in morality. Francis Galton made a study of famous divines, finding that "they are a moderately prolific race, rather under than above the average." This would seem to be explained by the fact that "they usually have wretched constitutions." College professors are probably as moral as ministers, however, and offer more material for study. If their racial contribution is considerably above or below the average, one can draw some inferences in regard to the amount of morality which the nation is likely to possess a few generations hence.

In the first place, there are large classes of them who are celibate. Such are, for the most part, the professors in the separate women's colleges; likewise the tutors and fellows in English universities.

A study of the past and present members of the faculty of the University of Illinois, as enumerated in the Alumni Record of 1913, has been made for the JOURNAL OF HEREDITY by W. L. Altman. The total number of individuals listed is 1,154, of whom 363 men and 123 women are single, that is, 42% of the total number. Many of these are young, however, and may marry later.

Of the remainder, there were 618

married men and 50 married women. The study was limited to those who had been married for at least 10 years, and whose families therefore should be nearly complete. This reduced the number to 387 men and 28 women.

The 387 men had altogether 806 children, or an average of 2.08 each. The 28 women has 26 children, or less than one apiece.

The latter figures perhaps indicate that children are much more of a handicap to a professional woman than they are to a professional man, since most of their care usually devolves upon the woman. More weight can be laid on the figures for the men; they confirm J. McKeen Cattell's researches, which showed that the two-child family is now practically standardized among American men of science.

A study made at the University of Wisconsin a few years ago showed, according to O. E. Baker, that the married members of that faculty had about 2.5 children each. This is a high figure for the professorial class, and is probably reached in very few universities.

It is scarcely necessary to point out that the two-child system is inadequate to ensure even the bare maintenance of a given section of the population. When a certain amount of premature mortality, and the failure of some to marry, are taken into account, it becomes evident that the group which limits itself to two children per family will steadily decline in numbers. If morality and intellectuality are, as we believe, due largely to heredity, then the amount of them in the population will become less each year.

### SOME UNLIMITED FAMILIES

There has been no such diminution in the fertility of groups that are not conspicuous for morality. It was found (according to O. E. Baker) that feebleminded persons who applied for relief to the Associated Charities of Madison, Wis., had families of 6.2 children, on the average.

To cite but one more study on this side of the ledger, A. H. Estabrook finds in his study of the great "Juke" family, a clan of several thousand imbeciles, criminals and ne'er-do-wells, that the women who have children have on the average 4.3 apiece. This is about twice the number borne by the college professors' wives.

Now mere quantity of children is of little concern to the eugenist. If the Juke women and their like were bearing *no* children, we could be well satisfied with the average of two from the college professors. It is the *relative* birth rate that occupies the eugenist's attention, and he cannot help feeling alarm at such tendencies as these figures indicate.

Certainly the college professors are in many cases not to be criticised for their small families; they must rather be commended for refusing to bring into the world more children than they can properly care for. The fault is more that of society than that of the individual. If society does not want to see the amount of morality diminishing with each generation, it must take some steps to get a larger birth rate from such a class as that of the college professors, and it should also take whatever steps are possible to reduce the racial contributions of the germinally anti-social—at least such as are mentally defective. These two problems make up nearly the whole of national eugenics. A good start has been made on the second, but little or nothing has been done on the first, which is really the more important.

The solution of the first is not a matter to be settled by the geneticist, but rather by the economist and sociologist. The geneticist can only point out the problem and emphasize as much as possible the urgency of its solution. Unless economic and social changes permit and encourage people of superior morality and intelligence to have more children, eugenics can make little progress. For the class of people typified by the college professor, children are today a liability. It is the task of the statesmanship of the future to make them an asset.

# INHERITED FEEDING HABIT OF HERONS

JOHN T. ZIMMER

*Bureau of Agriculture, Manila, P. I.*

RECENTLY I had the opportunity to observe a very curious habit possessed by two young herons, which was interesting from the standpoint of its possibly hereditary nature as well as for its peculiarity.

The birds belonged to the species *Pyrrherodia manilensis* (Meyen) and were kept in captivity by Alfred Worm of Manila. At the time in question they were being given their morning meal of partly dried fish, which were thrown to them on the floor of the verandah where the birds were kept. I noticed that they seemed to be having some little difficulty in securing the fish, and that they would peck at each one a number of times before finally obtaining it. Continued observation made it evident that the first efforts invariably fell short of the mark. The consistency of the mistakes in this particular suggested a clue to the explanation. Accordingly, to test out the theory, a few fish were thrown into a basin of water, where they sank to the bottom, and offered to the birds in that state. True to expectation, the herons unerringly picked these fish out of the water at the first attempt.

### LIGHT REFRACTION CAUSE OF ERROR

The explanation which presented itself to me, is based on the refraction of light. The submerged fish appeared to the observers to be somewhat more distant than they actually were, and hence the herons, in order to reach the mark, were obliged to aim at a point appreciably nearer than the apparent position of the object. This they seemed to do as a matter of course. Since, in a wild state, they would secure most of their food from shallow water, food consisting for a large part of prey which would escape if not obtained at the first attempt, this habit of rectifying the aim, to correct for refraction would be extremely advantageous if not indispensable. In the present case, however, it seemed to be present at the expense of ability to align the stroke in the direction of actual sight or at least to recognize the necessity for such alignment.

### UNABLE TO PROFIT BY EXPERIENCE

An interesting feature of the case was the apparent failure of the birds to profit fully by experience. Although they were able to find each object of search after a series of trials, at the next venture they reverted to their original, deflected aim. The persistence of this action leads me to believe that the habit is an inherited trait. I was told that the herons had been fed occasionally in water, since their capture some three weeks previously, but their rations had been given to them for the most part on the bare floor, and as they were taken from the nest when they were less than a week old, there is little chance that the performance was the result of experience, especially since experience seemed to have so little effect in overcoming the difficulty when circumstances demanded it. Whether or not the young herons will acquire greater proficiency in terrestrial feeding as they grow older, remains to be seen.

# CHINA'S TREES AND OURS STRIKINGLY ALIKE

**Three American Trees Have Their Only Non-American Relatives in China—Two Continents Probably Connected in Geologic Times—Isolation in Different Environments Has Not Produced Marked Changes in Trees**

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SEPARATED by eight thousand miles of ocean, and four thousand miles of land, the eastern part of North America and the forest areas of China present some striking resemblances in vegetation. Three species of forest trees which grow wild in both China and the United States, but nowhere else, are particularly noteworthy. They are the Tulip Poplar (*Liriodendron sp.*), the Sassafras (*Sassafras sp.*), and the Hickory (*Carya sp.*).

### ONLY TWO TULIP POPLAR SPECIES

The American Tulip Poplar (*Liriodendron tulipifera*) is one of the most beautiful of native flowering trees, its clean growth and handsome flowers making it justly admired (Fig. 9). The flowers greatly resemble the tulip and the young growth is very similar to that of the poplar. It is often known as "whitewood" in the West. The flowers are borne on the young growth of the current season and are bell-shaped and upright, being of a greenish-yellow color, orange within the base, solitary and entirely odorless. The leaves are a bluish-green and are borne on long stems, adding much to the beauty of the tree.

Its entire appearance is similar to that of the Magnolia, and this is not to be wondered at, since both belong to the order Magnoliaceae. The tree is one of the fastest growing, tallest, and largest of any of the forest trees. In a contest held by this Association in 1915, a Tulip Poplar discovered by John R. Hess, of Providence, R. I., proved to be the tallest tree reported in this country. It was 193 feet in height, with a circumference 4 feet above the ground of 34 feet 6 inches.

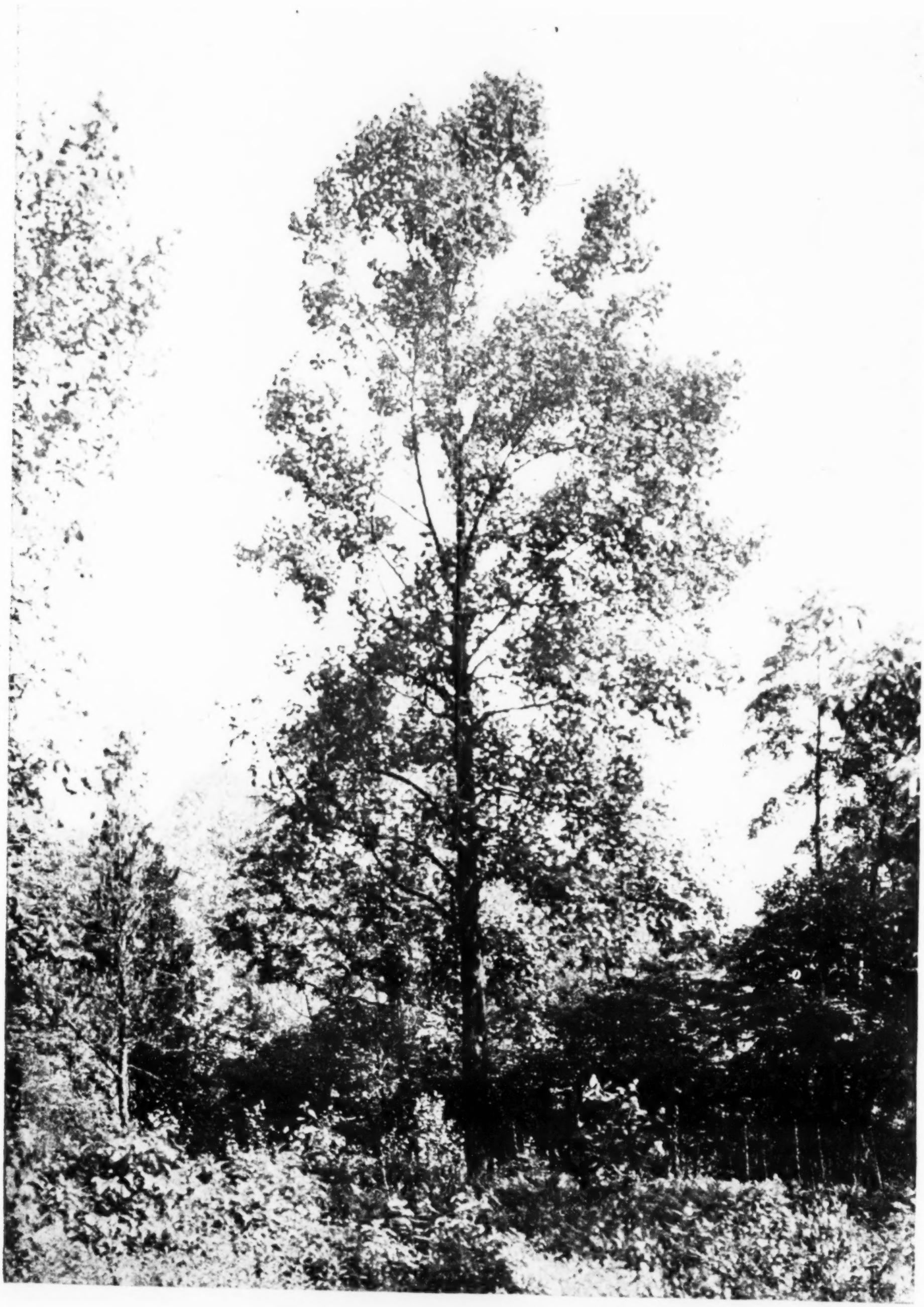
Of course, when the tree attains such an enormous height, it is almost impossible to see the flowers, and hence many of the young trees are headed when desired for ornamental purposes, thus being induced to keep a rounded outline and bear their flowers where they can be seen. The tree may be readily grown from seed.

The Chinese species, the only other of the genus (*L. chinensis*, Fig. 10), may well be called the Chinese counterpart of the American tree, for although it does not attain the immense height reached by the species in this country, the leaves are much the same shape, the flowers only a little smaller and the fruit somewhat elongate, the changes as a whole being trivial. It can be readily grafted on the American species. It grows rapidly when young, sometimes as much as 3 or 4 feet in one year. It is of vigorous constitution, and thrives best in good loamy soil.

### ONLY TWO SASSAFRAS SPECIES

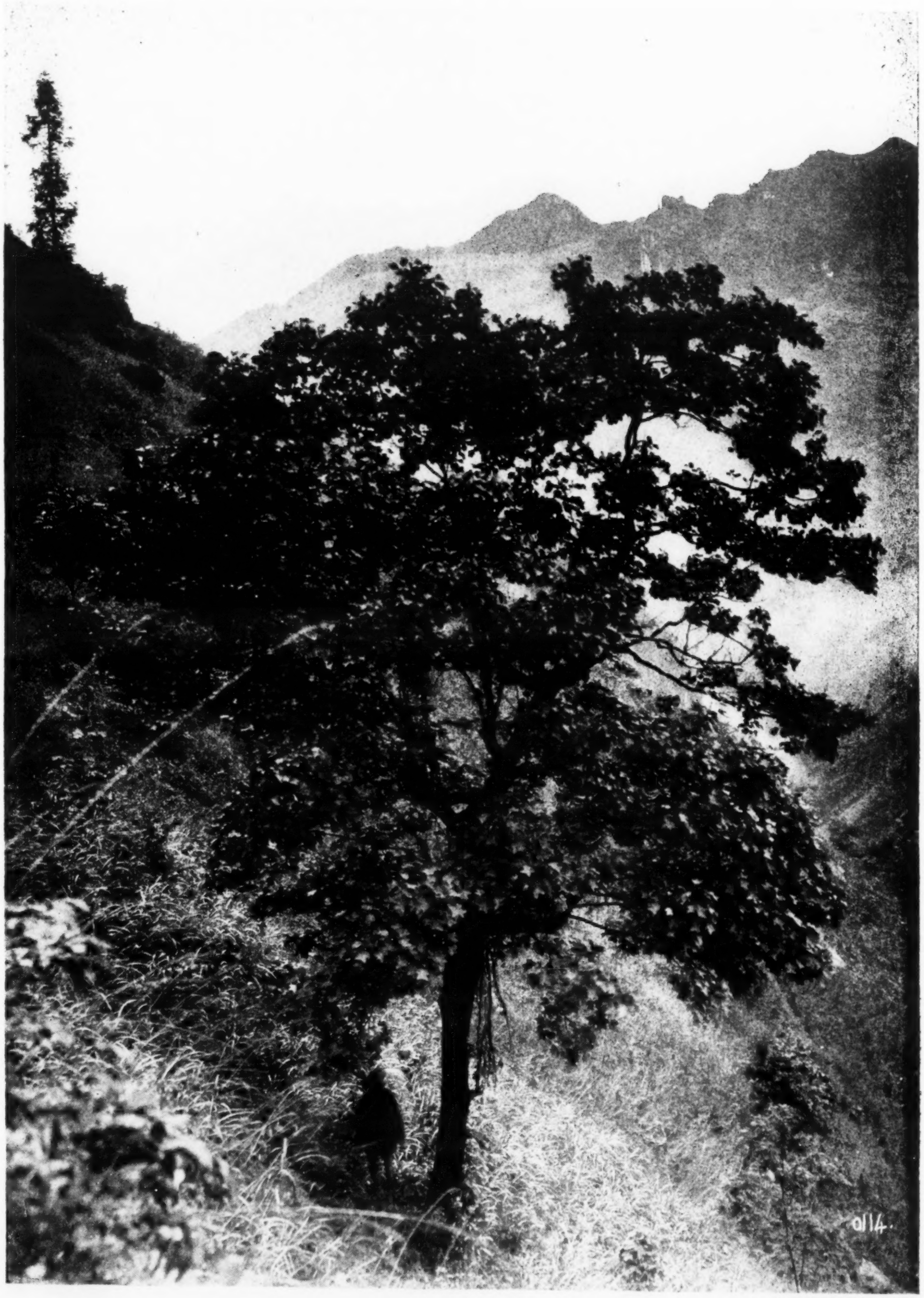
Due to its aromatic fragrance and the peculiarly piquant taste of leaves and bark, the Sassafras is a tree that is not soon forgotten by anyone who has ever made its acquaintance. A deciduous tree, the American species (*Sassafras sassafras*, Fig. 11) reaches a height of 50 to 70 feet, and a circumference of more than 14 feet was reported from Horsham, Pa., where the largest specimen in this country appears to exist.

The young shoots are sparsely downy at first, but later lose this characteristic. The flowers are greenish-yellow, produced in May, the sexes usually being on separate trees. The fruit is a dark blue, roundish oval, three-quarters of an inch long. The tree can withstand



**THE AMERICAN TULIP TREE**

One of the handsomest of American trees, the Tulip Tree (*Liriodendron tulipifera*), known in some parts of this country as Tulip Poplar or Whitewood, is of beautiful growth and produces flowers which make it justly admired. It is one of the fastest growing and tallest of forest trees and greatly resembles the Magnolia in general appearance. The flowers, which are borne on the young growth of the current season, are bell-shaped and upright, solitary and of a greenish-yellow color, orange within the base, and entirely odorless. The photograph was taken in Hamilton County, New York. (Fig. 9.)

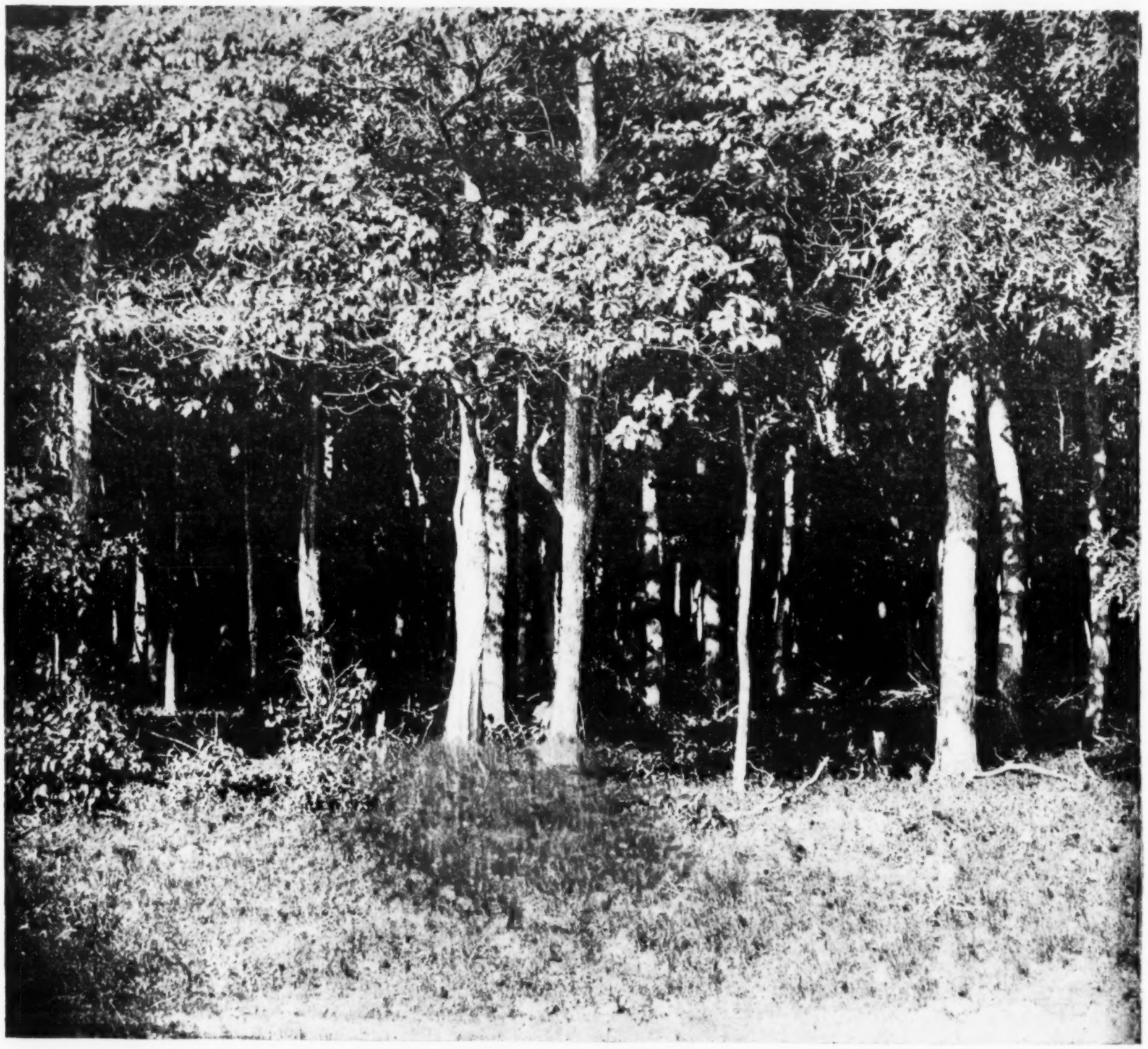



**CHINESE COUNTERPART OF THE AMERICAN TULIP TREE**

There are only two species of tulip tree known, one in Eastern North America, the other in Western China. Of vigorous constitution, the Chinese tulip tree (*Liriodendron chinensis*) is the Chinese counterpart of the North American tulip poplar or whitewood. It appears to thrive quite well when grafted on the American species, *L. tulipifera*, and differs only in the most minor characters from its American relative. Photograph from E. H. Wilson. (Fig. 10.)

**CHINESE COUNTERPART OF THE AMERICAN SASSAFRAS**

The Chinese Sassafras (*S. tzumu*) is the only other species of sassafras known besides the American. It reaches a height of 50 feet when growing wild and produces a timber which is much valued by the mountaineers of the region where it is found. Except for small differences, it is practically identical with the North American species. Photograph from E. H. Wilson. (Fig. 11.)



**GROWTH OF AROMATIC SASSAFRAS**

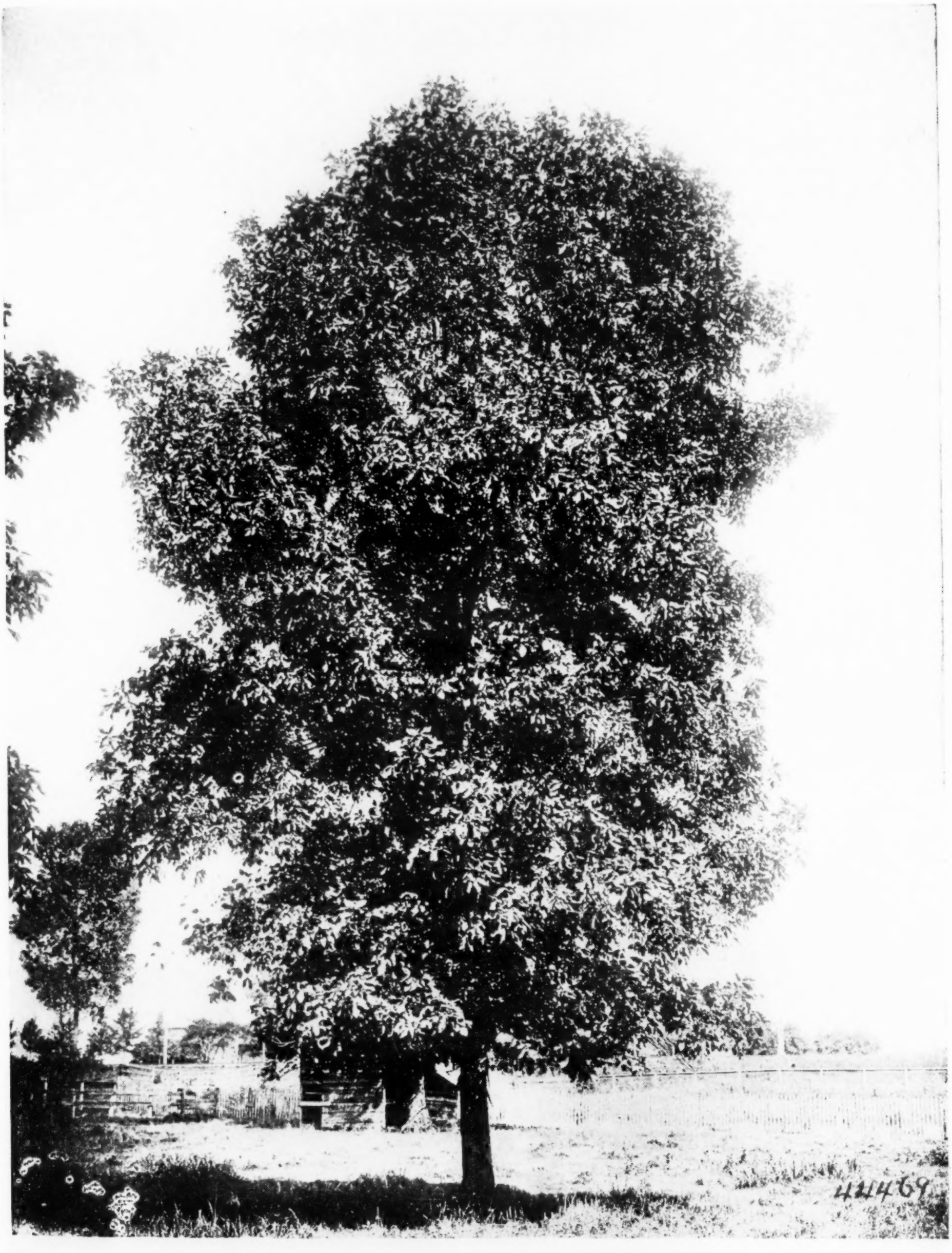
The aromatic and pungent fragrance of bark and leaves of this tree are well known. It reaches a height of 70 to 90 feet under favorable conditions. The young shoots are sparsely downy at first, but the heavier growth is covered with a rough bark. The fruit, which is a dark blue, roundish oval and about three-quarters of an inch long, is produced from greenish-yellow flowers which are borne in May, the sexes being on separate trees. Photograph by courtesy of U. S. Forest Service. (Fig. 12.)

severe frost, although when young the foliage is sometimes crippled. It prefers a warm, loamy soil, where it grows well.

The only other species of sassafras known, *S. tzumu* (Fig. 12), is found in many places in China. There are minor differences in the structure of the flower, and the young shoots and leaves are smooth. The leaves, with the principal veins, are reddish, and much of the young wood is purple-spotted. The Chinese species attains a height of 50 feet, and produces a timber which is highly prized by the mountaineers of the regions where it is found wild.

### CHINESE HICKORY DISCOVERED

Up to a short time ago, it was believed that the Hickory (*Carya sp.*) was confined entirely to the United States, where a score of distinct species are found. A rumor of a supposed Hickory growing in China was traced some years ago to the Candle Nut tree, and it was not until the discovery of *Carya cathayensis* by the late Frank N. Meyer, of the office of Foreign Seed and Plant Introduction, U. S. Department of Agri-




**THE AMERICAN SHAGBARK HICKORY**

This Shagbark (*C. ovata*), grown at Morenci, Michigan, is a good specimen of this type of tree, and has attained a height of more than 45 feet. The rather common oblong shape of the crown is very noticeable here, the outline of the tree being quite regular except for a few stray branches. As may be seen, the trunk is straighter and more slender than would be expected in a tree of such size. The name of the variety is suggestive of the roughness of the trunk. Photograph by courtesy of U. S. Forest service. (Fig. 13.)

**THE AMERICAN BITTERNUT HICKORY**

Of less compact growth than many other species, the Bitternut Hickory (*Carya cordiformis*) is perhaps all the more graceful. The name of the tree alone suggests the rather unpleasant quality of the nut, which, because of its flavor, is not so valuable as that of other species. The slender trunk may be seen rising almost to the top of the tree. This tree is growing at Morenci, Mich. Photograph by courtesy of U. S. Forest Service. (Fig. 14.)

**THE CHINESE COUNTERPART OF AN AMERICAN HICKORY**

It has always been assumed that no hickory trees were to be found outside of the United States until Meyer's discovery of the Chinese hickory (*Carya cathayensis*), near Hangchow. The tree pictured was a fruiting specimen growing at the base of a mountain. The bark is ashy grey with patches of white. This tree rarely attains a height of over 60 feet, and, at the age of 50 or 60 years, has passed its prime. Photograph by Frank N. Meyer, Foreign Seed and Plant Introduction, U. S. Department of Agriculture. (Fig. 15.)

culture, that a species of Carya was definitely located outside of the United States.

The American Hickory has been one of the most valuable of all our hard wood trees It is hard to imgaine how our forefathers could have done what they did to develop their country without its wonderful timber. It is found wild throughout almost the entire eastern half of the country.

The Hickory is among the most beautiful and useful of American forest trees, and makes an exceptionally ornamental park tree, with its straight, generally high, and slender trunk. The leaves are light green, changing to yellow or orange and orange-yellow in the fall, and form a graceful head of foliage, generally pyramidal or oblong in shape. The wood is heavy, hard, strong and tough, and is much used for making handles of tools, carriage wheels and similar work requiring a very durable wood. It also makes a fine fuel. The nuts are mostly edible, and orchards are planted to certain species, especially the Pecan (*Carya pecan*).

It thrives best in rich, moist soil, although certain varieties do well under drier conditions. It is slow of growth, and difficult to transplant, and hence the seeds are often planted where the tree is desired. The various species can be grafted on each other readily, the Bitternut (*C. cordiformis*), forming an especially good stock. The tree is somewhat subject to attacks by certain insects and fungi.

### CHINESE HICKORY STRIKINGLY SIMILAR

The Chinese Hickory (*C. cathayensis*, Fig. 15), recently discovered by Meyer, is a tree of 35 to 60 feet in height, and in every point has been proved to be a true hickory. It is found in Chekiang, and in the mountains around Changhua Hsien, about 70 miles west of Hangchou, growing at an elevation of about 400 feet above sea-level. The upper surface of the leaves has the soft greenish color typical of all the Hickories, while the under surface is rusty brown. Due to this peculiar coloration, a group presents a reddish-brown blotch of color in the midst of ordinary green vegetation, when the wind blows. The nuts are collected for sale, eaten as a sweetmeat, or made to yield fancy pastries. The wood is very tough and much used for tool handles. The inhabitants realize the value of the tree to them, and hence it is generally spared when firewood is being collected. In a few localities, the mountaineers have even made small plantations of this tree near their houses. It thrives best at the foot of mountains and in narrow moist valleys, where it grows in deep rich humus. It loves shelter, and when exposed to much wind is liable to become crippled; nor can it stand much frost.

Of these three American trees, the Liriodendron, the Sassafras, and the Carya, formerly supposed to be confined entirely to North America, each is now found to have a single species existing in China. Why this country, almost at the Antipodes, should be the locality where the only relatives of these trees are found outside of America is a question which is well worthy of consideration.

It has been decided by geologists that China and America were at one time united by land connection and that the present separation has not always existed. Hence, the trees just described probably grew continuously from China to the eastern United States, with but slight differences between different localities no greater than those now to be found between various parts of the United States.

When the land connection was severed, conditions were such that the trees became centered in the eastern part of this country and in localities of similar climatic conditions in China. The growth was now discontinuous, broken by the Pacific Ocean and the arid plains of the far west. Under such conditions, the Chinese and American species grew on and, although far apart and subject to different conditions, remained practically identical through hundreds of generations. In the two widely separated localities, due to their adaptability, these species were able to

survive, and present today one of the most striking examples of similarity in floras due to survival of related species after separation.

There appears to be not the slightest reason why such a tree as the Liriodendron should not be found in England or some European locality just as well as in China for when planted there it will grow and seed, and no explanation has yet been devised which points out any valid cause for its absence. It simply is not found there. But although its absence in Europe is not accounted for, its presence, together with the Hickory and Sassafras, in China forms a striking example of similarity in widely separated floras due to the survival, through adaptability, of three common species of American trees.

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## Lowered Birth Rate in Germany and Hungary

Although reliable statistics are now hard to secure, scattered but fairly representative reports indicate that the population of Germany is shrinking, more from a lowered birth rate than from actual casualties on the front, in spite of the efforts the German government is making to produce children for the fatherland

The statistics of the Mannheim Bureau giving birth and death rates before and after the outbreak of the war, as quoted in *Eugenical News*, March, 1918, are typical of the situation now existing. In 1914, the birth rate per thousand was 29.01, with a death rate of 13.13, leaving an excess of birth of 15.68 per thousand. In 1917, the birth rate has shrunk to 16.57, while the death rate, enlarged by war losses and abnormal conditions, has increased to 17.28, resulting in a deficiency of 0.71 per thousand in the birth rate. There is a great increase of deaths among persons over sixty years of age, due to the poor food and anxieties of war.

Hungary seems to be but little better off. The following statistics were read by the Karolyist deputy, Lodovico Hollo, to the Hungarian Chamber of Deputies, at the session of January 16, 1918.

"Births.—Before the war 765,000 children a year were born in Hungary. In the first year of the war, 1914, the number of births was reduced by 18.000; in 1915 only 481.000 children were born—that is, 284,000 less than in time of peace. In 1916 the number of births was 333.000—that is, a reduction of 432.000. In 1917 the births amounted to 328,000—that is, the reduction was 438.000. Therefore our losses (in Hungary alone) behind the front reach the number of 1,172.866 individuals.

"Deaths.—Whereas in time of peace infant mortality, for a period of seven years, was 34 per cent, in 1915, the proportion was increased to 48 per cent, and in 1916 to 50 per cent."

"These facts," said Hollo, "prove what sacrifices Hungary is making, to the prejudice of her own people, to continue the war."

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## Citrus Hybridization

In the spring of 1914 extensive hybridization of citrus fruits was begun at Riverside. Crosses have been made between varieties of orange, lemon, pomelo, and mandarin (tangerine), besides a few crosses of bergamot orange. These crosses are partly within the botanical species, for instance between Valencia orange and Mediterranean Sweet orange; many, however, are between different species, as between Dancy tangerine and Marsh pomelo.

# EE KEEPING MAY INCREASE THE COTTON CROP

## Fertilization of the Cotton Flower Takes Place Soon after Sunrise — Twenty-Five to Fifty Pollen Grains Necessary for Each Flower — Shedding of Bolls Often Due to Imperfect Fertilization

ROWLAND M. MEADE, *Bard, Cal.*[1]

THE percentage of cotton flowers that develop into mature bolls is generally low. Even under the most favorable conditions many of the buds do not reach the blooming stage, and many flowers that open fail to set bolls.

A test of twelve Upland varieties made at Bard, Cal., in 1911, showed that during the first thirty days of flowering, 44 to 66% of the flower buds aborted before opening, and that 22 to 52% of the flowers that opened failed to develop into bolls. An examination of all the nodes on the fruiting branches at which it would have been possible for bolls to develop showed that at only 12 to 23% of these nodes were bolls produced.

In the same series of varieties at San Antonio, Tex., in 1912, 35 to 82% of the flowers that opened failed to mature bolls. The shedding at San Antonio was doubtless due largely to unfavorable climatic conditions, as drought, and, also, to the depredations of the boll weevil. The boll weevil, however, is not present at Bard, and as irrigation is practiced the lack of water could hardly be an important factor. Inadequate pollination was considered as a possible cause of the shedding, when the flowering stage had been reached.

The cotton flower is a large, cup-shaped blossom; it is borne in an upright position on the upper side of the fruiting branch. The structure and relation of floral parts are shown in Fig. 16. The pollen grains are very large and have moist spinose surfaces, so that they tend to cohere when freed from the anthers and are not carried about by the wind.

### PERIOD OF FERTILIZATION SHORT

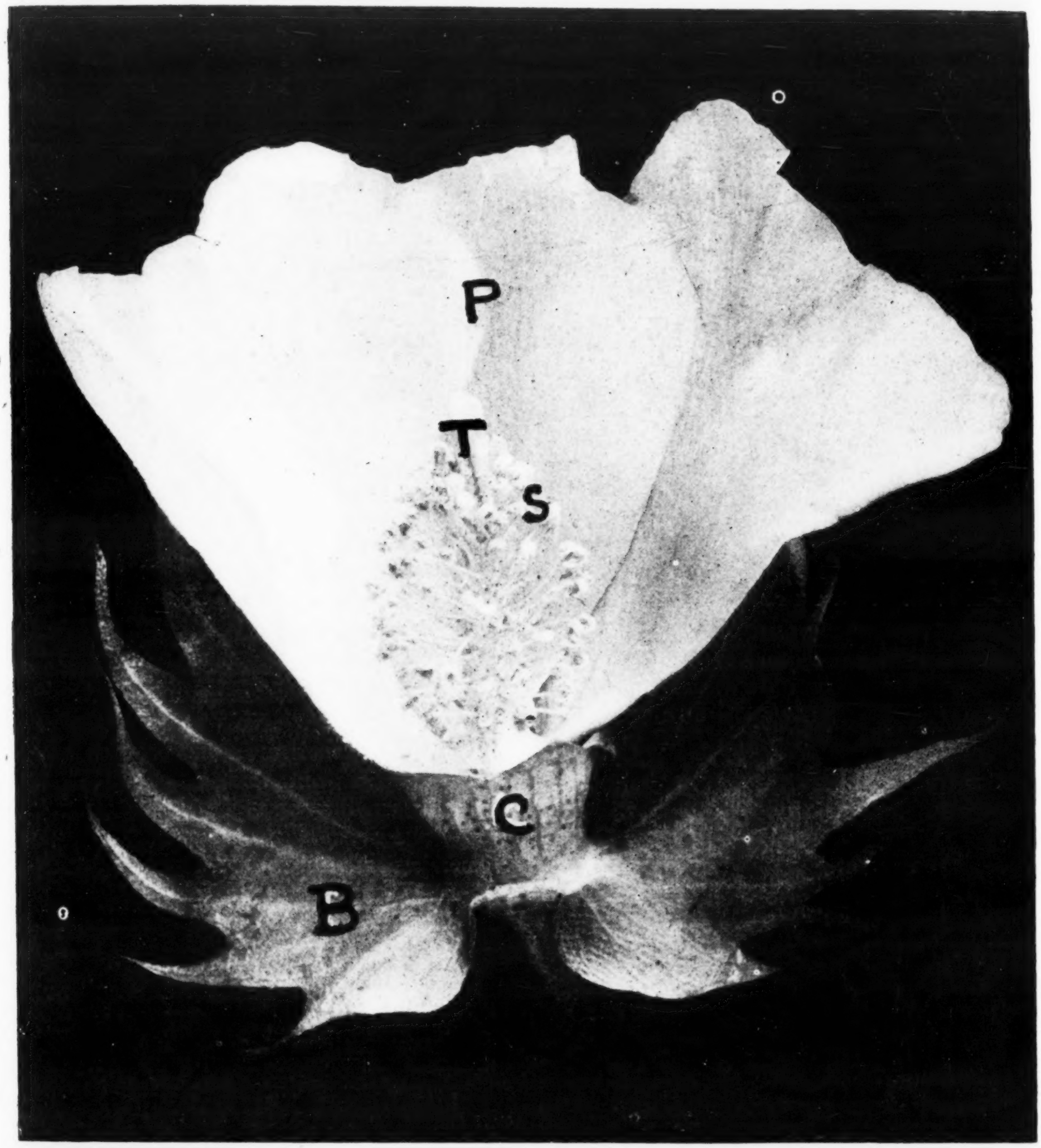
The period during which fertilization is possible lasts only a few hours. The flowers open soon after sunrise, commence to wither as the temperature rises in the middle of the day, and close in the evening, when the stigmas are dry. The second or third day after blooming the petals, stamens, and pistil separate from the rest of the flower and fall from the plant.

In some types the relative position of the stigmas and stamens is favorable, and in others unfavorable, for self-pollination. This doubtless partially accounts for the differences between varieties with respect to the percentage of flowers that develop into bolls.

### LONG STAPLE COTTON OFTEN SELF-STERILE

Most of the flowers with long stigmas projecting above the stamens do not become completely self-fertilized, as the anthers and stigmas are too widely separated. The flowers of many of the long staple varieties are of this type, the stigmas often exceeding the anthers by 15 mm. (See Fig. 17.) The bolls resulting from such flowers have 23 to 50% of aborted seeds, and it seems not unreasonable to attribute this abortion in part to the lack of perfect pollination. Flowers with short stigmas imbedded among the upper stamens are readily

[1] This report was found among the papers of the late Rowland M. Meade in essentially the same form as presented.—J. H. Kempton.

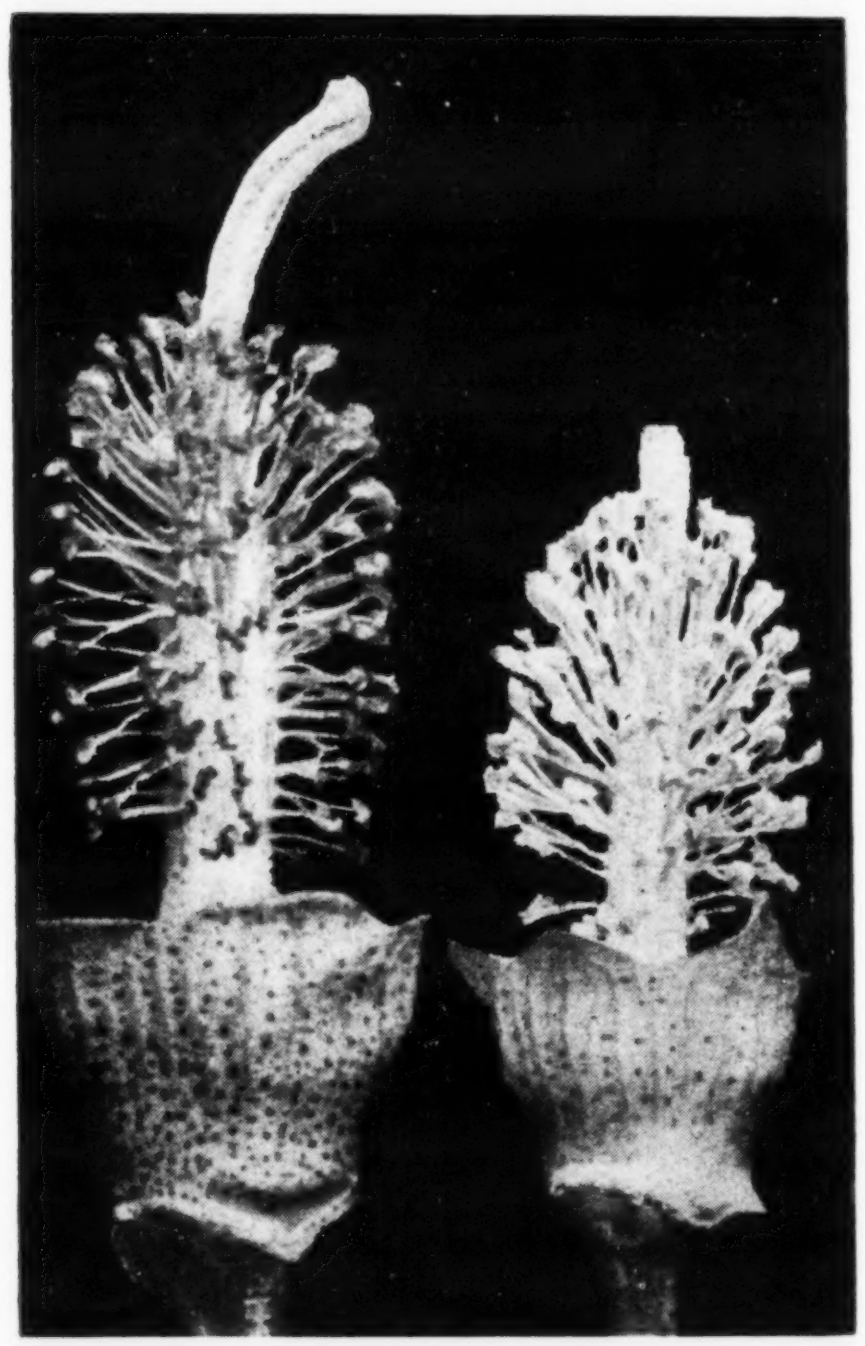



**AN UPLAND COTTON FLOWER**

A dissected flower enlarged two diameters to show construction. *B*, bracts; *C*, calyx; *S*, stamens; and *P*, petals. *T*, stigma protruding above the stamens. Insects can easily visit the stamens and collect pollen without ever touching the pistil which projects above the stamens. (Fig. 16.)

self-fertilized. Such an arrangement is shown in Fig. 17. Erect stamens, either long or short, are also favorable to self-fertilization, since they bring the anthers in close proximity to the pistils.

Cotton bolls have three to five locks or compartments, each containing six to eleven ovules, the number varying with the type of cotton. Few locks of long staple types contain more than nine seeds, while most of those of big-bolled, short, staple types have at least eight seeds, but mature bolls in which all of the seeds are fertile are rare. In the bolls of Upland varieties 10% to 25% of the ovules fail to develop into seeds. There is usually a slightly higher percentage of aborted seeds in the bolls of the long staple types.



**COTTON FLOWER TYPES**

Section of an Upland X Egyptian cotton flower on left, showing long exserted pistil. Flowers of this type are seldom completely self-fertilized. Section of a short stapled Upland cotton flower on right, with short pistil imbedded among the stamens. Flowers of this type are usually self-fertilized. Enlarged two diameters to show detail. (Fig. 17.)

### LARGE AMOUNT OF POLLEN NEEDED

It was found by preliminary investigation that the bolls failed to set unless at least twenty-five grains of pollen were applied to the stigmas; even with this number only one or two seeds matured in each lock. As each lock contains from six to eleven ovules, it is necessary for at least twenty-five to fifty-five grains of pollen to reach the stigmas in order that all the ovules of a four or five-locked boll be fertilized.

An experiment was conducted at San Antonio, Tex., during 1913, to determine whether an increase in boll production might be expected as the result of complete pollination. Two varieties of cotton were chosen for this investigation—Durango, a long, staple type with stigmas exserted beyond the stamens, and Acala, a short, staple type with short stigmas embedded among the stamens. The separation of the anthers from the stigmas in the Durango flowers reduces the chance of self-fertilization, while the conditions found in Acala cotton favor self-fertilization. Two rows of each variety were planted for this experiment.

### EXPERIMENT EXPLAINS DIFFERENCE

One of the rows of each variety was designated as *A* and the other as *B*. The flowers in the *A* rows were completely self-pollinated, anthers being removed by hand, and the pollen scattered over the pistil until the stigmas were well covered. The flowers in the *B* rows were allowed to become pollinated naturally.

A small string tag with the date of opening of the blossom was securely fastened about the branch at the base of the flower to mark the position of each flower that failed to develop into a boll. The hand pollination in the *A* rows produced the effect that might be expected from the work of bees or other pollinating insects operating in great numbers, except that the manipulation of the stigmas may have been slightly injurious. There were no indications of this, however, and, as far as possible, normal conditions were provided.

The experiment was carried on during the early part of the season, when conditions were favorable for growth, and were discontinued after July 10, because of extreme drought and the presence of boll weevils.

At the end of the season a complete record was taken of the matured bolls and of the vacant nodes bearing tags. It was thus possible, each day's record having been kept separately, to determine the percentage of flowers of each day that developed into mature fruit.

### ARTIFICIAL POLLINATION BETTER

The results of the experiment are shown in Table I (see Appendix). As was anticipated, better results (an increase of nearly 11%) were obtained by artificial pollination in the Durango cotton than in the Acala variety, in which the increase was only about half as great. As before stated, the flowers of the former have exserted pistils, not adapted for perfect self-pollination, while those of the latter variety have short pistils.

The lowest percentages of bolls produced were found in the open pollinated rows of both varieties, while the highest percentages were found in the hand pollinated rows. In the open pollinated row of Durango, the lowest and highest percentages of bolls produced were 11 and 69.6, respectively; in the hand pollinated row, 32 and 81, respectively. In the open pollinated Acala row the lowest and highest percentages were 23 and 59, respectively; in the hand pollinated row, 34.8 and 65.5, respectively.

No effort was made to exclude insects, and the weather conditions during the course of the investigation were not unfavorable to their activities. It is evident from the increased yield of bolls secured in the long-pistiled Durango variety through artificial pollination that the presence of additional pollinating insects would aid in reducing the high percentage of shedding. The value of honey bees in this connection is recognized in some localities, and it would seem that growers of long-stapled varieties might find bee-keeping a distinct advantage to the cotton crop.

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## Counting the Feeble-minded in New York

After going over the ground carefully, the Committee on Mental Hygiene of the New York State Charities Aid Association submitted to the Hospital Development Commission an estimate of the number of feeble-minded in the State, and placed the number conservatively at 35,000. *The Eugenical News*, March, 1918, makes the just criticism that "counting" the feeble-minded is largely a subjective matter, and that many farmers would gladly pay $2.00 a day and board during harvest to a feeble-minded youth who would be unable to be self-supporting in New York City.

However, this estimate of the Mental Hygiene Committee, although doubtless far from being an actual count, should do much toward awakening public feeling to the necessity for adequate provision for the feeble-minded and feebly inhibited.

# APPENDIX

## The Cow in Calf Deserves More Honor

(*See article on page 250*)

TABULATION OF RECORDS OF 1,497 COWS ENTERED IN THE 1916 VOLUME OF THE REGISTER OF MERIT PUBLISHED BY THE AMERICAN JERSEY CATTLE CLUB.

| Age of cow years | No. of cows studied | Milk yielded, pounds | Fat yielded, pounds | Requirements, fat, lbs. | Requirements are less than production | 30% less than actual production lbs. fat | 22% less than actual production lbs. fat | Standardized to 25% less than production lbs. fat |
|---|---|---|---|---|---|---|---|---|
| | | | | | A | B | C | D |
| 1 yr. A | 86 | 6267.3 | 337.7 | 250.5 | 26% | 236 | ..... | 253 |
| AA | 67 | 6226.5 | 335.9 | | | | | |
| 2 yr. A | 278 | 6707.3 | 359.2 | 250.5 | 30% | 250 | 280 | 269 |
| AA | 224 | 6712.6 | 362.4 | | | | | |
| 3 yr. A | 126 | 7495.9 | 399.1 | 287 | 28% | 279 | ..... | 299 |
| AA | 96 | 7082.5 | 383.6 | | | | | |
| 4 yr. A | 112 | 8230.8 | 449.4 | 323.5 | 28% | 314 | ..... | 337 |
| AA | 73 | 7747.8 | 417.5 | | | | | |
| 5 yr. A | 91 | 8221.9 | 441.5 | 360 | 19% | 309 | 344 | 331 |
| AA | 57 | 8307.8 | 430.6 | | | | | |
| 6 yr. A | 60 | 8489.9 | 460.1 | 360 | 22% | 322 | ..... | 345 |
| AA | 52 | 8167.5 | 429.6 | | | | | |
| 7 yr. A | 47 | 9029.5 | 477.1 | 360 | 25% | 334 | ..... | 358 |
| AA | 29 | 8171.7 | 439.4 | | | | | |
| 8 yr. A | 29 | 8754.8 | 461.8 | 360 | 22% | 323 | ..... | 346 |
| AA | 16 | 8507.6 | 464.7 | | | | | |
| 9 yr. A | 25 | 8718.2 | 476.6 | 360 | 25% | 333 | ..... | 357 |
| AA | 10 | 8456.2 | 442.6 | | | | | |
| 10 yr. A | 11 | 8887.6 | 463.8 | 360 | 22% | 323 | 360 | 348 |
| AA | 8 | 8916.0 | 460.1 | | | | | |
| Average | ..... | ..... | ..... | ..... | 25% | | | |

## Bee Keeping May Increase the Cotton Crop

(*See article on page 282*)

TABLE I.—*Comparison of percentages of bolls developing from open pollinated and hand pollinated flowers in Acala and Durango cotton, San Antonio, Tex., 1913*

Durango cotton

| Date of flowering | Hand pollinated row | | | Open pollinated row | | | Difference in favor of hand pollinated row | Average difference in favor of hand pollinated row |
|---|---|---|---|---|---|---|---|---|
| | No. of flowers | No. of bolls setting | Percentage of bolls produced | No. of flowers | No. of bolls setting | Percentage of bolts produced | | |
| June 27 | 25 | 8 | 32.0 | 27 | 3 | 11.0 | + 21.0 | |
| 28 | 17 | 7 | 41.2 | 26 | 10 | 38.4 | + 2.8 | |
| 30 | 29 | 19 | 65.5 | 22 | 8 | 36.3 | + 29.2 | |
| July 1 | 44 | 26 | 59.1 | 36 | 25 | 69.5 | − 10.4 | |
| 2 | 66 | 43 | 65.2 | 64 | 36 | 56.3 | + 8.9 | |
| 3 | 59 | 44 | 74.6 | 60 | 41 | 68.3 | + 6.3 | |
| 5 | 73 | 48 | 65.8 | 52 | 32 | 61.5 | + 4.3 | 10.96 ± 2.2 |
| 7 | 75 | 61 | 81.2 | 79 | 55 | 69.6 | + 11.6 | |
| 8 | 84 | 64 | 76.2 | 62 | 58 | 61.3 | + 14.9 | |
| 9 | 94 | 70 | 74.5 | 86 | 57 | 66.2 | + 8.3 | |
| 10 | 69 | 56 | 81.2 | 66 | 38 | 57.5 | + 23.7 | |

Acala cotton

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| June 27 | 8 | 4 | 50.0 | 9 | 4 | 44.5 | + 5.5 | |
| 28 | 16 | 8 | 50.0 | 13 | 3 | 23.0 | + 27.0 | |
| July 1 | 29 | 19 | 65.5 | 37 | 22 | 59.4 | + 6.1 | |
| 2 | 54 | 25 | 46.2 | 62 | 35 | 56.5 | − 10.3 | |
| 3 | 66 | 28 | 42.5 | 76 | 39 | 51.3 | − 8.8 | |
| 5 | 62 | 26 | 41.9 | 70 | 22 | 31.4 | + 10.5 | 5.31 ± 2.45 |
| 7 | 89 | 31 | 34.8 | 109 | 45 | 41.4 | − 6.6 | |
| 8 | 118 | 39 | 38.0 | 110 | 23 | 21.0 | + 17.0 | |
| 9 | 145 | 61 | 42.0 | 163 | 63 | 38.6 | + 3.4 | |
| 10 | 122 | 57 | 46.8 | 152 | 57 | 37.5 | + 9.3 | |